New York State Tributary Strategy

for

Chesapeake Bay Restoration

An Interim Plan based on the Chesapeake Bay Program Watershed Model, Version 4.3

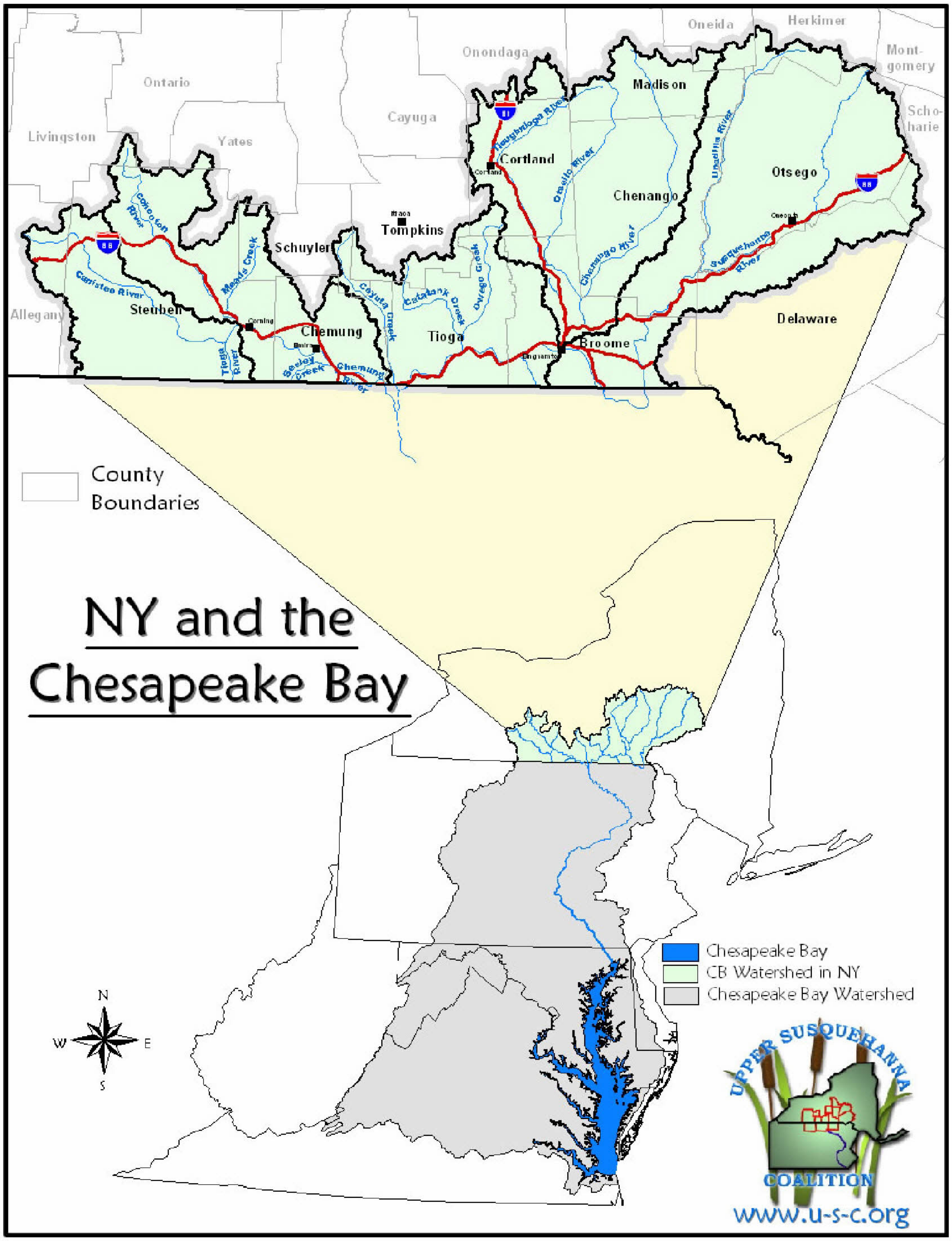
Developed by the

New York State Department of Environmental Conservation

In partnership with the

Upper Susquehanna Coalition

2006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Acknowledgements:

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Acronyms:

AEM	New York State Agriculture Environmental Management Program
AMA	Agricultural Management Assistance
CAA	Federal Clean Air Act
CAFO	Concentrated Animal Feeding Operation
CAIR	Federal Clean Air Interstate Rule
CBP	Chesapeake Bay Program
CNMP	Comprehensive Nutrient Management Plan
CREP	FSA Conservation Reserve Enhancement Program
CRP	FSA Conservation Reserve Program
DAM	New York State Department of Agriculture and Markets
DEC	New York State Department of Environmental Conservation
DOH	New York State Department of Health
DOW	Division of Water
EPA	United States Environmental Protection Agency
EQIP	NRCS Environmental Quality Incentive Program
FSA	USDA Farm Service Agency
GIS	Geographical Information System
GLCI	Grazing Lands Conservation Initiative
LEV	Low Emission Vehicle
MS4	Municipal Separate Storm Sewer System
NRCS	United States Natural Resource Conservation Service
OSG	Upper Susquehanna Coalition Outreach Support Group
OWTS	On-site Wastewater Treatment System (typically residential septic system)
PFFM	Precision Feed and Forage Management
RIBS	New York State Rotating Intensive Basin Surveys
RGGI	Regional Greenhouse Gas Initiative
SCWCS	NYS Susquehanna Comprehensive Wildlife Conservation Strategy
SDAG	Upper Susquehanna Coalition Strategy Development Advisory Group
SIP	CAA State Implementation Plan
SPDES	New York State Pollutant Discharge Elimination System
SSG	Upper Susquehanna Coalition Scientific Support Group
SWCC	New York State Soil and Water Conservation Committee
SWCD	New York State Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USC	Upper Susquehanna Coalition
VSA	Variable Source Area
WHIP	Wildlife Habitat Improvement Program
WI/PWL	New York State Waterbody Inventory/Priority Waterbodies List
WRAPS	New York State Watershed Restoration and Protection Action Strategy
WRP	USDAWetland Reserve Program
WWTP	Wastewater Treatment Plant

Executive Summary

Chesapeake Bay is the largest estuary in the United States. It is about 200 miles long with more than 1,600 miles of shoreline in its many coves, wetlands and tidal tributaries. It provides habitat to more than 3,600 different species of plants and animals and produces nearly 500 million pounds of seafood per year. The Chesapeake Bay (Bay) watershed covers 64,000 square miles and includes more than 16 million people in portions of 6 states (Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia) and the District of Columbia.

The New York portion of the Bay watershed consists of the Chemung and Susquehanna River basins and includes more than 6,250 square miles in 19 counties with a population of about 650,000 people. New York makes up about 10 percent of the total Bay watershed area and 4 percent of the total population. Although continued population growth since the early 1980s is an overarching challenge facing the Bay, population in the New York portion of the Bay watershed has declined.

The Bay has been significantly degraded since at least 1980 from excess sediment and nutrients (nitrogen and phosphorus) entering its waters. Primary nutrient sources are sewage, cattle manure, inorganic fertilizer and atmospheric nitrogen deposition. Primary sediment sources are agriculture, stream bank erosion and construction.

Monitoring data shows generally good water quality in New York and that nutrient and sediment levels are declining. This is largely due to a strong water stewardship ethic and an increasing amount of forest land cover. However, to meet Bay restoration goals, a substantial amount of nutrient reduction from New York is necessary.

In 1983, a voluntary government partnership, first championed by private citizens, formed to direct and manage Bay restoration efforts. That partnership, called the Chesapeake Bay Program (CBP), included Maryland, Virginia, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and the United States Environmental Protection Agency (EPA).

Although the CBP has made great efforts, continued water quality impairments within the Bay led the EPA and Bay states to list more than 90 percent of Bay tidal waters as "impaired" under the Federal Clean Water Act due to low dissolved oxygen levels and other problems related to nutrient and sediment pollution. In 2000, a federal court order required the development of a Chesapeake Bay Total Maximum Daily Load (TMDL) if Bay water quality impairments are not rectified by 2010. This spurred the CBP to reach out to the "headwater" states of New York, West Virginia and Delaware to more formally participate in the CBP.

In 2000, Governor George Pataki signed a Memorandum of Understanding to agree to work cooperatively with the EPA and other tributary states and the District of Columbia to improve Chesapeake Bay Water Quality.

Using complex computer models, the CBP developed a total yearly load for **Nitrogen**, **Phosphorus** and **Sediment** that it considered the maximum amount the Bay could receive and still meet water quality standards. It is important to recognize that to model a 64,000 square-mile watershed, it is necessary to generalize land uses by major categories. Although doing so makes the final model output reasonably accurate on a broad scale, it also creates uncertainty at smaller scales and when high levels of implementation are expected because the effectiveness of most practices is very site-specific.

In 2003, the CBP water quality technical work group and steering committee, which included representatives from each Bay watershed state including New York, developed an allocation[1] of the total yearly loads to each state. The allocations are called **Cap Load Allocations** and each state, including New York, is committed to developing and implementing a tributary strategy. Tributary strategies outline how nutrient and sediment loads delivered to the Bay could be reduced in order to achieve Cap Load Allocations as predicted by version 4.3 of CBP Bay Watershed Model. They are living documents meant to be amended as better information is obtained.

Because the models predict New York will be well under the sediment allocation in future years, this tributary strategy focuses on reducing nutrients from New York. Although the strategy does not focus on actions to reduce sediment, sediment is an important local concern and this strategy will help address that concern because many nutrient reduction practices also act to reduce sediment.

To develop the New York Tributary Strategy, the New York State Department of Environmental Conservation (DEC) has partnered with the Upper Susquehanna Coalition (USC, www.u-s-c.org) to help provide local input and technical support. The USC is a bi-state network of county natural resource professionals whose mission is to conserve the soil and water resources of the headwaters of the Susquehanna River and Chesapeake Bay watersheds.

The USC includes representatives from the 13 New York counties that make up a vast majority of the New York portion of the Bay watershed. They are well suited to develop, implement and track many of the nonpoint aspects of this strategy. To organize tributary strategy development, three work groups were formed: outreach, scientific support and strategy development.

The following table displays 2006 nutrient levels predicted by the Bay Watershed Model and a **Tributary Strategy Goal** for each major source category, which would achieve the nutrient cap load allocations for New York. These goals are based upon the best professional judgment of the DEC and the USC.

[1] EPA document 903-R-03-007, dated December 2003 and entitled "Setting and Allocating the Chesapeake Bay Basin Nutrient and Sediment Loads: The Collaborative Process, Technical Tools and Innovative Approaches" describes the allocation process.

The overall objective is to seek the greatest amount of cost-effective reduction from each source category. New York's cap load allocations and tributary strategy goals may change as scientific understanding of nutrient movement through the watershed advances, more refined models are developed and nutrient reduction practices become more efficient. A formal process to reevaluate all cap load allocations in connection with version 5 of the Bay Watershed Model is scheduled to occur in 2009 and, if necessary, to develop a bay wide TMDL by 2011. Preliminary indications are that version 5 will show less nitrogen loading from New York than earlier models. In the interim, **New York will use this document as its planning tool to support projects that contribute to achieving current tributary strategy goals**. For individual projects, a priority is placed on those that have the most local benefit and that are most cost-effective.

Table 1. Susquehanna Nutrient Loads leaving New York and Tributary Strategy Goals (1000s of pounds per year)

Source Category	Nitrogen		Phosphorus	
	2006 model Estimate	**Tributary Strategy Goal**	2006 Model Estimate	**Tributary Strategy Goal**
Agriculture	12,100	**7,900**	954	**613**
Forest/Other Open Space*	12,600	**10,300**	283	**155**
Wastewater**	3,700	**2,300**	476	**234**
Urban Stormwater	2,000	**1,500**	127	**84**
Septic System	1,300	**1,200**	0	**0**
Total***	31,700	**23,200**	1,840	**1,086**
Cap Load Allocation ******		**12,580**		**590**

*Other Open space includes surface water.

**For significant Bay facilities, the 2006 model estimate is based upon assumed discharge volumes and assumed nutrient concentrations of 15.7 mg/l nitrogen and 2.0 mg/l phosphorus. The annual 2005 model scenario shows for wastewater about 3.3 million pounds of nitrogen and 500 thousand pounds of phosphorus. The Tributary Strategy Goals are based upon maximum discharge volume allowed under existing State Pollutant Discharge Elimination System permits.

***The total does not include potential nitrogen reductions from forest resulting from reductions in atmospheric deposition, because such reductions are not quantifiable in the Bay Watershed Model. With the quantifiable management practice implementation levels suggested in this strategy, the Bay Watershed Model predicts the nitrogen generated from New York will be 25,002,773 pounds. This translates in the model to 13,606,875 pounds of delivered load which is within 8 percent of the Cap Load Allocation. The CBP states that being within 8 percent is acceptable given planned improvements in modeling and the pending re-allocation process. For phosphorus, the load generated from New York is 1,052,380 pounds. This translates in the model to 554,661 pounds of delivered load which is below the Cap Load Allocation.

****The CBP Bay Watershed Model predicts that about half of the nutrients generated in New York do not make it to the Bay. This "delivery factor" number is important because all present cap load allocations were developed by apportioning the "delivered load" among the watershed states and Washington D.C. "Delivery factor" accuracy is also important to Bay Watershed Model predictions of future nutrient levels delivered to the Bay.

The following table depicts factors affecting implementation and the overall priority of implementation for each major source category. **Because of the large amount of reduction that is technically and administratively achievable, agricultural practices and wastewater treatment upgrades are the highest overall priority for implementation**. With the exception of urban stormwater where costs are largely incorporated into the costs of development, all major source categories will require substantial financial support.

Table 2. Nutrient Reduction Magnitude, Achievability Factors and Overall Implementation Priority

Source Category	**Overall Magnitude of Reduction**	**Achievability**			**Overall Priority for Implementation**
		technical capability	economic capability	administrative capability	
Agriculture	*High*	*High*	*Low*	*High*	*High*
Forest/Other Open Space*	*High*	*Medium*	*Medium*	*Low*	*Medium*
Wastewater	*High*	*High*	*Low*	*High*	*High*
Urban Stormwater	*Low*	*Medium*	*Medium*	*High*	*Medium*
Septic System	*Low*	*High*	*Medium*	*Medium*	*Low*

* Anticipated reduction from forest and other unmanaged open space is largely due to decreased atmospheric nitrogen deposition.

This Tributary Strategy describes a road map to gain reductions through both regulated activities, mostly in the wastewater source category, and voluntary and incentive-based nonpoint source activities, such as those related to agriculture. It describes how the Cap Load Allocations can be met using adaptive management. Details of such phased approaches are found in the major source category chapters of this strategy.

In general, New York's approach is to first develop a list of potential point and nonpoint load reduction practices that are considered practical if there is sufficient funding, staffing and time necessary for implementation. Resolving model uncertainties, management practice innovations and continued water quality monitoring will determine whether implementation levels will change. Following is a brief description of the strategy for each major source category.

Agriculture Source Category

About 3,500 farms of all types exist in the New York portion of the Chesapeake Bay watershed, covering about 1,000,000 acres or 25 percent of the landscape. Of these about 1,400 are dairies. The dairies are generally small (less than 100 cows), with only about 86 reaching the "concentrated animal feeding operation" (CAFO) regulatory threshold of more than 200 cows.

The agriculture strategy focuses on dairies because they import the most nutrients and hold the most promise for cost-effective nutrient reduction. **The total cost of achieving the tributary strategy goals is estimated by the USC to be about $240,000,000.** About half of this cost is for animal waste systems. Because they are costly and an important consideration when developing and implementing comprehensive nutrient management plans, suitable alternative approaches may be appropriate on certain farms and shall be considered. Main elements of management practice implementation:

- **Animal Waste Systems**: An additional 600 constructed systems
- **Comprehensive Nutrient Management Plans**: Increase from 14 to 71 percent of available acreage
- **Conservation Tillage**: Increase from 7 to 36 percent of available acreage
- **Cover Crops**: Increase from 0 to 54 percent of available acreage
- **Prescribed Rotational Grazing and/or Stream Fencing with Off-site Watering**: Increase from 13 to 78 percent of existing pasture acreage (about 15% of total agricultural lands)
- **Precision Feeding**: Implement on about 250 dairy farms
- **Riparian Buffers**: Increase from 12 to 38 percent of available acreage
- **Voluntary Land Retirement**: Increase from 5,400 acres to 18,400 acres
- **Wetland Restoration**: An additional 3,300 acres

Forest and Other Open Space Source Category

Forested land covers about 2,900,000 acres or about 71 percent of the landscape and represents the second-largest source of nitrogen, largely because of atmospheric nitrogen deposition. This area of New York receives a high amount of deposition, largely from sources outside of the State.

Although atmospheric deposition affects all land uses, it is discussed in this source category because there is no deposition management practice, and it has the greatest effect on this large land cover type. Without significant nitrogen load reductions from forested land, higher reductions from other source categories are necessary. New York has already undertaken significant actions, including:

- Adoption of **year-round NOx controls at power plants**
- Adoption of **low-emission-vehicle standards** for NOx and CO_2
- Adoption of the **Regional Greenhouse Gas Initiative**
- Initiation of the collaborative **Renewable Energy Portfolio**

Because much of the Open Space land use category acreage is believed to be old farm fields that are reverting to brush land and emergent forests, it has been converted to forest in the Bay Watershed Model to more accurately portray the level of fertilizer application.

Significant reductions from air sources outside of New York are likely needed to achieve the Tributary Strategy goal. **The cost of achieving this Tributary Strategy goal is unknown.** Yet, air emission controls for nitrogen removal are generally cost effective.

Wastewater Source Category

The wastewater strategy focuses on nutrient reduction from the 28 largest wastewater treatment plants (WWTP) in the watershed and includes the following:

- To reduce nutrient loads, ensure **compliance with existing regulatory requirements**, particularly those related to wet weather controls.
- To achieve the phosphorus tributary strategy goal, virtually **all such significant WWTPs will need to add phosphorus removal treatment.**
- To achieve the nitrogen tributary strategy goal, **a subset of the largest WWTPs will need to add nitrogen removal treatment**. The Binghamton-Johnson City WWTP, which represents about 25 percent of the flow from the 28 facilities, is now under construction to add such nitrogen removal treatment.

Based upon preliminary engineering assessments, **the total cost of achieving the Tributary Strategy goals is estimated to be about $200,000,000**.

Urban Stormwater Source Category

The urban stormwater strategy relies upon continued implementation of statewide stormwater programs. These include the construction general permit and emerging municipal separate storm sewer (MS4) programs and the following:

- **MS4 programs** improve understanding of the source loads and the efficiency of management practices
- Although modest levels of more costly structural management practices are suggested, non-structural practices, such as **tree planting and street cleaning** are more likely to be cost effective and have greater local benefits and acceptance
- **Education and outreach** to municipal officials and property owners is important and is supported by statewide Nonpoint Source Program funding

In addition, members of the lawn care product manufacturing industry have agreed to achieve a 50 percent reduction in pounds of phosphorus applied in lawn care products in the Chesapeake Bay watershed by 2009 as compared to a 2006 base year.

Because of the site specific nature of urban stormwater management practices, it is difficult to estimate a total cost. An estimate is provided based upon average costs to implement several thousand acres of stormwater treatment ponds, wetlands, infiltration systems and erosion and sediment control practices. **A rough estimate of $25,000,000 is provided.** Much of this total cost will be covered by developers and by municipalities through existing regulatory requirements.

Septic System Source Category

Although a large number (approximately120,000) of septic systems exist, they make up a minor fraction (3 percent) of the nitrogen load. The septic system strategy includes a **standard septic tank pumping management practice** applied to all systems. This practice preserves the effective life of a septic system, which has local benefits. New York has an existing outreach and education program to septic system owners.

Relatively few and localized water quality impairments caused by nutrients or sediment exist in the Susquehanna-Chemung Basin, and levels of phosphorus, nitrogen and sediment in streams are declining. The condition of New York's waters reflects the strong local stewardship ethic and the results of effective water pollution control programs. Water quality in this region is not facing significant pressure related to population growth and urbanization. Consequently, implementation of pollutant reduction projects to reach the tributary strategy goals also acts to protect such high water quality from degradation. Protection is a worthy investment in the long term because it is typically more cost effective than restoring already degraded water quality.

To achieve the tributary strategy nutrient goals, this strategy relies largely on continuation and enhancement of existing programs rather than creation of new ones. This strategy also recognizes that funding is necessary for the significant level of actions suggested to achieve the nutrient reduction goals. To reduce such costs, this strategy promotes those items which are most cost effective and reliable in the long term, improve water quality, reduce flooding and increase valuable habitat. The overall high cost, multiple jurisdictions and the national importance of Chesapeake Bay warrant substantial federal financial support.

Special Note:

Record floods of June 2006 caused loss of life and substantial property and natural resource damage throughout much of this area of New York. The DEC is still in the process of evaluating the impacts of this event. While this strategy remains New York State's plan to achieve nutrient reductions so as to help achieve the water quality goals of Chesapeake Bay, priorities for project implementation also will consider the need to effect recovery and flood damage prevention efforts in the region.

Chapter One INTRODUCTION

Background

Chesapeake Bay (Bay) is the largest estuary in the United States. It is about 200 miles long with more than 11,600 miles of shoreline in its many coves, wetlands and tidal tributaries. It provides habitat to more than 3,600 different species of plants and animals and produces nearly 500 million pounds of seafood per year. Much of the Bay is shallow, being less than 6 feet deep, which contributes to its biological productivity but adds to its sensitivity to pollution. The Chesapeake Bay watershed covers 64,000 square miles, and includes more than 16 million people in portions of six states (Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia) and the District of Columbia.

The Bay has been significantly degraded since at least 1980 from excess sediment and nutrients (nitrogen and phosphorus) entering its waters. Excess nutrients cause algal blooms, which block the sunlight underwater bay grasses need to grow, and rob other living resources of oxygen when they die. Sediment can smother bottom-dwelling plants and animals, such as oysters and clams, prevent light from penetrating to submerged aquatic vegetation and carry excess nutrients, particularly phosphorus, into Bay waters.

Primary nutrient sources are municipal wastewater, cattle manure, inorganic fertilizer and atmospheric nitrogen deposition. Nutrients are conveyed to streams from point sources, such as wastewater treatment plants and nonpoint sources such as septic systems, agricultural lands and urban stormwater runoff. Sediment sources include construction sites, roadways, stream bank erosion and cropland. As more land is developed, urban and suburban lands become more significant contributors. The New York portion of the Bay watershed is not experiencing significant development pressure. An increase in forest cover is the most significant land use change in New York.

In 1983, a voluntary government partnership, first championed by private citizens, formed to direct and manage Bay restoration efforts. That partnership, called the Chesapeake Bay Program (CBP), included Maryland, Virginia, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and the United States Environmental Protection Agency (EPA). The CBP serves as a model for dozens of other national estuary cleanup efforts, such as Casco Bay, Long Island Sound, Tampa Bay, Monterey Bay, Puget Sound and others.

Although the CBP has made great efforts, continued water quality impairments within the Bay led the EPA and Bay states to list more than 90 percent of Bay tidal waters as "impaired" under the Federal Clean Water Act, due to low dissolved oxygen levels and other problems related to nutrient and sediment pollution. In 2000, a federal court order required development of a Chesapeake Bay Total Maximum Daily Load if Bay water quality impairments are not rectified by 2010. This spurred the CBP states to reach out to "headwater" states of New York, West Virginia and Delaware to more formally participate in the CBP.

In 2000, New York State Governor George Pataki, through a Memorandum of Understanding, joined executives from the other Chesapeake Bay watershed states and the federal government in agreeing to:

- "Work cooperatively to achieve the nutrient and sediment reduction targets that we agree are necessary to achieve the goals of a clean Chesapeake Bay by 2010, thereby allowing the Chesapeake and its tidal tributaries to be removed from the list of impaired waters
- Provide for an inclusive, open and comprehensive public participation process
- Collaborate on the development and use of innovative measures such as effluent trading, cooperative implementation mechanisms, and expanded interstate agreements to achieve the necessary reductions"

The agreement stimulated efforts in New York to develop and implement a detailed "Tributary Strategy." This strategy shows how New York can specifically help to further reduce nutrients and sediments delivered to the Bay. The New York State Department of Environmental Conservation (DEC) has partnered with the Upper Susquehanna Coalition (USC), to help provide local input and technical support.

Established in 1992, the USC is a network of county natural resource professionals who regularly convene to develop strategies, partnerships, programs and projects to protect the headwaters of the Susquehanna River and Chesapeake Bay watersheds. The USC includes representatives from 13 counties in New York. This critical partnership has provided the venue for combining efforts to meet the tremendous challenges described in this strategy.

This Tributary Strategy describes a road map of implementation activities that are regulated, incentive based or voluntary. Nutrient and sediment reductions are expected from existing requirements, such as state regulations governing stormwater runoff ("Phase 1 and 2"), concentrated animal feeding operations (CAFO) and wastewater treatment plants (WWTP). Other strategy implementation activities are largely voluntary and incentive based, especially those related to agriculture where several funding and cost sharing programs already exist to support such efforts. It is also clear that a commitment to technical assistance and public education/outreach and thorough regulatory oversight is necessary to meet and sustain the Tributary Strategy goals.

Due to the complexity of the issue, high costs to implement the large number of practices expected, lack of available funds to support such efforts and the sheer "gearing up" needed to accomplish all tasks, it appears that the implementation timeline will reach at least well into the next decade. To hasten implementation, considerable enhanced federal financial support is needed, particularly for agricultural practices and WWTP upgrades.

This strategy describes a practical, cost-effective approach to reach New York's nutrient and sediment Tributary Strategy goals should sufficient funding become available.

The New York Landscape

The headwaters of the Susquehanna River originate in New York. The Susquehanna River watershed is the second largest east of the Mississippi and the largest on the Atlantic seaboard. This 27,500 square mile watershed drains portions of New York, Pennsylvania and Maryland before emptying into the Bay, where it provides half the Bay's fresh water. The Susquehanna River also empties into the head of the Bay. This maximizes the retention of its nutrients and sediments in the Bay compared to any other drainage.

The Susquehanna River headwaters lie within the Appalachian Plateau, covering 6,265 square miles of south-central New York, or about 13 percent of the state. It includes the Susquehanna River (4,521 square miles) and Chemung River (1,744 square miles) watersheds. An additional 1,230 square miles of the headwater area is in Pennsylvania and drains into New York. Portions of 19 New York counties are included and about 650,000 people reside there. Population trends have been decidedly downward; the major municipalities have each lost about 20 percent of their population between 1970 and 2000. Loss of jobs and population is also reflected in the rather high percent of population falling below the poverty line, about 22 percent.

Geology of the region is characterized by rocky glacial till, with a land cover composed of 71 percent forest and wetlands, 23 percent agriculture, 5 percent urban/suburban and 1 percent open water. General land use trends have been an increase in forest, a decrease in agriculture and urban/suburban remaining about the same. The Susquehanna headwaters are one of the most flood-prone regions in the nation. Since the early 1800s, the main stem of the Susquehanna River has flooded on average every 20 years. Due to its topography, the Susquehanna watershed is also vulnerable to frequent localized flash floods, which occur every year.

Water quality in the New York portion of the Bay watershed is generally good. New York's list of impaired waters under the Federal Clean Water Act includes only two waterbodies in this region that are impaired due to phosphorus levels (Lake Salubria, Steuben County and Whitney Point Reservoir, Broome County), and no segments are impaired due to nitrogen or sediment pollution. In addition, 2 stream segments are listed due to pathogen contamination and 14 segments have fish consumption advisories, primarily due to atmospheric deposition of mercury.

In general, water quality and quantity issues are closely linked with stream erosion, gravel deposition and flooding, which have both local and regional significance and result in stream channelization, gravel removal and road ditch repairs. Agriculture and wastewater treatment plants are important nutrient sources. Local issues concerning groundwater nitrification, septic system discharges, gravel mining, residential/retail development and acidic mine drainage waters also exist. The region's lakes are generally shallow, except for Otsego Lake, and eutrophic, with weed problems due to nutrient enrichment from septic systems, streambank erosion and agriculture.

Because few impaired waterbodies exist, New York tributary strategy goals and management practice implementation levels are generally discussed for the New York portion of the Bay watershed as a whole.

Other New York Chesapeake Bay Watershed Plans and Assessments

The Waterbody Inventory/Priority Waterbody List
The DEC Division of Water (DOW) maintains an extensive inventory of the state's water resources. This inventory, the Waterbody Inventory/Priority Waterbodies List (WI/PWL), also provides summaries of general water quality conditions, tracks the degree to which the waterbodies support a range of uses and monitors progress toward the identification and resolution of water quality problems, pollutants and sources. The 2004 NYS Water Quality 305(b) report describes the comprehensive strategy to evaluate the quality of water resources in the state. This evaluation uses a watershed approach. Details can be found on DEC's website at http://www.dec.state.ny.us/website/dow/bwam/305b.html. It is the information from the WI/PWLW that is used to compile the Clean Water Act Section 305(b) Water Quality Report.

The New York State Watershed Restoration and Protection Action Strategy: Susquehanna and Chemung River Basins (WRAPS) This strategy was developed in 2000 and 2001 through a partnership among key stakeholders: United States Department of Agriculture Natural Resources Conservation Service, New York State Department of Health (DOH), New York State Department of Environmental Conservation (DEC), the Upper Susquehanna Coalition (USC), Southern Tier Regional Planning and Development Board and Susquehanna River Basin Commission. The purpose of developing the strategy was to bring together appropriate agencies and stakeholders to identify important needs and focus financial, technical and informational resources on addressing those needs so that water and natural resources are restored, preserved and protected. The majority of concerns in the basin focus on correcting situations where occasional water quality or quantity conditions or habitat degradation periodically discourage or diminish the use of the waterbody. This tributary strategy builds from this effort by promoting local water quality and quantity objectives that also contribute to Chesapeake Bay restoration goals.

Susquehanna Comprehensive Wildlife Conservation Strategy (SCWCS) President Bush signed the Department of the Interior and Related Agencies Appropriations Act, 2002, into law on November 5, 2001. This bill included $80 million for wildlife conservation grants to states. The Fish and Wildlife Service is apportioning funds to New York under the State Wildlife Grants portion of Public Law 107-63.

New York's strategy is based on major watersheds. The SCWCS was developed by the DEC and other interested organizations and individuals, including the USC. It describes actions that will protect, support and enhance species of greatest conservation need. To the extent possible, goals of the SCWCS are integrated into the Tributary Strategy. The SCWCS can be viewed at http://www.dec.ny.gov/animals/30483.html

The Tributary Strategy Development Process
Three support groups were formed in 2003 to help with strategy development and inform stakeholders and challenge all involved to help. The workgroup members include:

New York State Department of Environmental Conservation
New York State Department of Agriculture and Markets
New York State Department Soil and Water Conservation Committee
Upper Susquehanna Coalition
County Soil and Water Conservation Districts
New York Farm Bureau
Center for Watershed Studies, Binghamton University
The Water Resources Institute
North American Nitrogen Center, Cornell University
State University of New York, Oneonta Biological Field Station
Alfred University
Cornell Cooperative Extension
Broome and Chemung Environmental Management Councils
Broome County Department of Health
Southern Tier Central Regional Planning and Development Board
United States Geologic Survey
Susquehanna River Basin Commission
Private Citizens

The **Outreach Support Group** (OSG) is providing an accurate and consistent message that informs watershed stakeholders of tributary strategy goals, roles of those involved and status of strategy development. It also solicits input and feedback, thereby encouraging stakeholder participation and acceptance. Outreach materials, which include a fact sheet, brochure and presentation, can be found on the USC's website, www.u-s-c.org. Outreach efforts began with USC county members meeting with various stakeholder groups. Initial efforts included 130 separate presentations. A series of county meetings were held in 2005 with DEC staff to provide an opportunity for feedback directly to the DEC on stakeholder suggestions. The OSG is expected to continue to provide outreach support to help implement the Tributary Strategy.

The **Scientific Support Group** (SSG) is providing scientific advice and Geographical Information System (GIS) support for assessing nonpoint source load reductions, monitoring, substantiating management measures and evaluating the effectiveness and costs of implementation measures. SSG members are interested academics and agencies.

The **Strategy Development Advisory Group** (SDAG) is providing recommendations to the DEC on strategy development so that the Tributary Strategy can be coordinated with and supported by efforts to address local water quality concerns. The SDAG has assisted the USC and the DEC in soliciting a broad range of representation and focusing local input on issues that advance strategy development.

Nutrient and Sediment Cap Load Allocations and Assigning Tributary Strategy Goals

The CBP has developed extensive information on its website on the sources of nutrients and sediment (http://www.chesapeakebay.net/info/wqcriteriatech/tributarytools.cfm.) After considerable analysis and stakeholder participation, the CBP developed the following total yearly estimates for nitrogen, phosphorus and sediment that it considered the maximum amount the Chesapeake Bay could receive and still meet water quality standards.

The CBP also developed allocations for each Bay state, including New York. EPA document, 903-R-03-007, dated December 2003 and entitled "Setting and Allocating the Chesapeake Bay Basin Nutrient and Sediment Loads: The Collaborative Process, Technical Tools and Innovative Approaches" describes the allocation process and may be found on the website indicated above.

Table 3. **Chesapeake Bay Program Loads**

Pollutant	Chesapeake Bay Annual Load	New York State Allocation	Equivalent Allocation (as generated in New York)
Nitrogen	**175** million pounds	**12.58** million pounds	**23.12** million pounds
Phosphorus	**12.8** million pounds	**0.59** million pounds	**1.12** million pounds
Sediment	**4.15** million tons	**0.131** million tons	**0.262** million tons

The CBP's Bay Watershed Model (Model) is a tool needed to understand which combination of land uses and management practices provide the most cost-effective opportunities to reduce nutrients and sediment.

In the current version of the Model (version 4.3) each land use category, through a complex series of analyses, is given a unique sediment and nutrient runoff load value on a per acre basis. These values are adjusted, due to differences in variables such as rainfall and practices involved, to estimate an "edge-of-stream" load for each watershed segment. The Model predicts nutrient and sediment loads "delivered" to the Bay from that watershed, considering what is lost along the way through natural stream processes.

Although New York allocations are "delivered" load, this strategy mainly refers to "edge-of-stream," or the load "as generated in New York," because these are estimates where reductions from management practices can be assessed. "Delivered" load is discussed where appropriate.

A more refined version of the Model (version 5.0) is undergoing calibration and is expected to be approved for management application early in 2008. At that time version 5 can be used to evaluate load reduction alternatives. Having been calibrated to a long term Susquehanna River monitoring station closer to New York at Towanda, PA, preliminary indications are that version 5 will show less nitrogen loading from NY than earlier models. Version 5 also increases the number of land use categories from 10 to 21 and increases the number of Model watershed segments in New York from 2 to 156.

This more refined version will assist planning efforts and may result in changes to the specific source category Tributary Strategy goals in the table below. Version 5.0 is also expected to be used as part of the planned CBP reevaluation of the nutrient and sediment load allocations scheduled in 2009 and, if necessary, to develop a bay wide TMDL by 2011. This reevaluation also may result in changes to this Tributary Strategy.

The major source category Tributary Strategy goals are generally set so the cost for the next incremental load reduction would be relatively similar in each category. The goals may change as better information is developed on actual nutrient loads and the costs and public support for various management practices and approaches.

The DEC, in consultation with the USC, considered several factors to achieve an appropriate and reasonable balance among the source categories:

- Magnitude and certainty of nutrient sources
- Efficiency and sustainability of management practices
- Management practice cost effectiveness among and within source categories
- Voluntary implementation supported by funding
- Equity and fairness between categories associated with reasonable responsibility for nutrient sources
- Resulting local water quality or natural resource benefits

The following table lists the nutrient Tributary Strategy goal (as generated in New York) for each source category compared to model predictions of existing loads. Because the Bay Watershed Model predicts New York will be well under its sediment allocation without additional management practices, only nitrogen and phosphorus Tributary Strategy goals are assigned.

Table 1. Susquehanna Nutrient Loads leaving New York and Tributary Strategy Goals (1000s of pounds per year)				
Source Category	**Nitrogen**		**Phosphorus**	
	2006 model Estimate	**Tributary Strategy Goal**	2006 Model Estimate	**Tributary Strategy Goal**
Agriculture	12,100	**7,900**	954	**613**
Forest/Other Open Space*	12,600	**10,300**	283	**155**
Wastewater**	3,700	**2,300**	476	**234**
Urban Stormwater	2,000	**1,500**	127	**84**
Septic System	1,300	**1,200**	0	**0**
Total***	31,700	**23,200**	1,840	**1,086**
Cap Load Allocation ******		**12,580**		**590**

*Other Open space includes surface water.
**For significant Bay facilities, the 2006 model estimate is based upon assumed discharge volumes and assumed nutrient concentrations of 15.7 mg/l nitrogen and 2.0 mg/l phosphorus. The annual 2005 model scenario shows for wastewater about 3.3 million pounds of nitrogen and 500 thousand pounds of phosphorus. The Tributary Strategy Goals are based upon maximum discharge volume allowed under existing State Pollutant Discharge Elimination System permits.
***With the implementation levels suggested in this strategy, minus those not quantified to forests as a result of reductions in atmospheric deposition, the Bay Watershed Model predicts the nitrogen generated from New York will be 25,002,773 pounds. This translates in the model to 13,606,875 pounds of delivered load which is within 8 percent of the Cap Load Allocation. The CBP states that being within 8 percent is acceptable given planned improvements in modeling and the pending re-allocation process. For phosphorus, the load generated from New York is 1,052,380 pounds. This translates in the model to 554,661 pounds of delivered load which is below the Cap Load Allocation.
****The CBP Bay Watershed Model predicts that about half of the nutrients generated in New York do not make it to the Bay. This "delivery factor" number is important because all present cap load allocations were developed by apportioning the "delivered load" among the watershed states and Washington D.C. "Delivery factor" accuracy is also important to Bay Watershed Model predictions of future nutrient levels delivered to the Bay.

This strategy seeks the greatest nutrient reductions from agriculture and wastewater treatment plant (WWTP) source categories because nutrient reduction technologies and management approaches are well established and generally most cost effective. As opposed to agriculture, where a large assortment of management practices can be applied in finite increments, WWTP upgrades tend to require major capital investments, and studies described in the Wastewater Section show considerable variability in cost effectiveness, particularly for nitrogen removal.

Because of the high level of nitrogen from the Forest/Other Open Space source category and the impracticality of reducing nitrogen runoff from extensive forestlands, this strategy recognizes the important role of atmospheric nitrogen deposition. Future substantial reductions from this source category are needed to achieve overall cost-effective reduction in this Tributary Strategy.

Nitrogen from this source category is due largely to atmospheric deposition from emission sources outside of New York. New York's nitrogen allocation in 2003 accounted for atmospheric deposition reductions that were projected from the EPA Clear Skies Initiative. Since then, the EPA promulgated the Clean Air Interstate Rule (CAIR) to require substantial reductions in nitrogen oxides from power plants. The EPA estimates that CAIR will result in significantly less nitrogen being delivered to Chesapeake Bay.

New York has regulatory and other air program initiatives that likely will result in more reductions, as will some of the agricultural practices outlined in this strategy. Although model quantification of these reductions is not available at this time, when coupled with a better understanding of actual atmospheric deposition of nitrogen and its fate and transport in forested watersheds, this strategy anticipates approximately 18 percent reduction from the Forest/Other Open Space category.

As explained in more detail in the Forest and Atmospheric Deposition Section of this Tributary Strategy, the impact of atmospheric nitrogen deposition on forests and other open space is an important area for further research. In addition, promising practices are being studied that may increase the ability of forests to uptake or denitrify nitrogen deposition. Because the research is relatively new and limited, management practice efficiencies have yet to be determined. Also, more needs to be understood of the practical ramifications, including cost and property owner acceptance, as well as the overall effect on the forest ecosystem and natural resources. So, rather than rely on such emerging management practices, this strategy accounts for potential reductions by decreases in atmospheric deposition.

Chapter Two MAJOR SOURCE CATEGORIES

Agriculture

The New York State Agricultural Environmental Management (AEM) Program
The New York State AEM Program was codified into law in 2000. Its goal is to support farmers in their efforts to protect water quality and conserve natural resources, while enhancing farm viability. AEM provides a forum to showcase the soil and water conservation stewardship farmers provide. It also provides information to farmers about Concentrated Animal Feeding Operation (CAFO) regulatory requirements, which helps to assure compliance. Details of the AEM program can be found at the New York State Soil and Water Conservation Committee (SWCC) website, http://www.nys-soilandwater.org/aem/index.html.

Using a voluntary approach to meet local, state and national water quality objectives, AEM has become the primary program for agricultural conservation in New York. It also has become the umbrella program for integrating/coordinating all local, state and federal agricultural programs. For instance, farm eligibility for cost sharing under the SWCC Agricultural Nonpoint Source Abatement and Control Grants Program is contingent upon AEM participation.

AEM core concepts include a voluntary and incentive-based approach, attending to specific farm needs and reducing farmer liability by providing approved protocols to follow. AEM provides a locally led, coordinated and confidential planning and assessment method that addresses watershed needs. The assessment process increases farmer awareness of the impact farm activities have on the environment and by design, it encourages farmer participation, which is an important overall goal of this Tributary Strategy.

The AEM Program relies on a five-tiered process:
Tier 1 – Survey current activities, future plans and potential environmental concerns
Tier 2 – Document current land stewardship; identify and prioritize areas of concern
Tier 3 – Develop a conservation plan, by certified planners, addressing areas of concern tailored to farm economic and environmental goals
Tier 4 – Implement the plan using available financial, educational and technical assistance
Tier 5 – Conduct evaluations to ensure the protection of the environment and farm viability

County AEM Strategies: Agricultural Planning for the New York Tributary Strategy
In 2004, the SWCC initiated a process for each county to develop an AEM strategic plan. Its purpose is to describe how the county will, usually on a watershed basis, communicate AEM goals to farmers, assess and prioritize farms and implement agricultural management practices. These plans ensure that a consistent AEM message is delivered statewide, that the process is adequately reviewed and that implementation efforts are enhanced through coordinated planning efforts.

All counties in the New York portion of the Chesapeake Bay (Bay) watershed subscribe to the AEM program. Fourteen of 19 counties, representing more than 97 percent of the Bay watershed in New York, have specifically acknowledged in their AEM Strategic Plan the need to work toward achieving the Tributary Strategy goals. This need will be addressed by implementing local projects that have downstream benefits and additional projects especially targeting Bay needs. Current funding levels in programs available to implement agriculture practices are insufficient to accomplish the Tributary Strategy goals.

With few locally impaired waters and in the spirit of the AEM voluntary approach, this Tributary Strategy presents overall goals for the entire New York portion of the Bay watershed. Because implementation is largely organized at the county level, each county is challenged, considering their unique circumstances, to garner as much farmer participation and implementation as current funding allows and to work toward securing additional funding support.

The USC provides watershed-wide support, digitally maps the New York landscape, stimulates new initiatives, tracks implementation efforts and fosters higher levels of farmer participation. The USC focuses on coordinating basin-wide nonstructural initiatives (e.g., precision feeding, rotational grazing, wetland restoration, riparian buffers, nutrient management), while pursuing funds for a wider range of structural and nonstructural practices implemented by individual counties. This approach offers the best opportunity to implement farm appropriate practices in a cost effective and efficient manner and maximize use of available funds.

Status of Agriculture in the Chemung and Susquehanna River Basins

One goal of this strategy is to continue to improve baseline data so that the most current agricultural information is used. Because all indications are that agricultural operations are declining in the upper Susquehanna watershed, the CBP may have overestimated nutrient loads from New York by using older data (e.g., 2002 Ag Census). The CBP estimate of agricultural data in New York is presented in the table below:

Table 4.

Basin	Total Ag (acres)	Alfalfa	Pasture	Disturbed stream in pasture	Hay w/nutrients	Hay w/o nutrients	Conservation Till crops w/manure	Conventional Till crops w/manure	All crops w/o manure	Nursery	Cows (K's)	Beef (K's)
Chemung	289,295	31,390	77,304	388	74,683	34,900	1,479	58,624	6,908	3,619	19 K	31 K
Susq.	646,807	81,421	211,775	1,064	159.459	61,781	14,127	107,604	2,952	6,624	85 K	97 K
Total	936,102	112,811	289,079	1,452	234,142	96,681	15,606	166,228	9,860	10,243	104 K	128 K

The following table, with data collected by the USC, represents the best available at this time. The most common farms in the New York portion of the Bay watershed are dairy and beef farms. Row crops and hay are grown largely to support these operations. Eighty-six of the 88 permitted concentrated animal feeding operations (CAFO) are dairy farms. Beef farms are usually much smaller and more widely dispersed. Although the CBP has estimated more beef than dairy in New York, the USC is reviewing this information. Small horse farms are becoming more numerous, and the USC will enumerate this agricultural sector to determine its size and impact. About 1,900 farms are located in the Chemung River Basin, representing about 26 percent of the land cover. Farms are relatively small; only 17 reach CAFO permit size (i.e., dairy farms with more than 200 cows). About 2,500 farms are located in the Susquehanna River Basin, representing about 22 percent of the land cover, with 71 CAFOs.

Table 5. Watershed	County	Estimated number of farms[1]	Farm AEM assessments completed[2]	AEM Planning projects[3]	CAFO[4]	Dairy
Chemung Basin	Alleghany	36	2	20	6	16
	Chemung	380	31	155	2	31
	Livingston	6	0	0	0	0
	Schuyler	120	23	104	0	6
	Steuben	1325	212	156	8	270
	Ontario	1	0	0	1	0
	Yates	8	0	0	0	0
Chemung Basin	**All**	**1876**	**269**	**443**	**17**	**323**
Susquehanna Basin	Chemung	5	0	0	0	0
	Schuyler	20	7	17	1	2
	Tioga	208	111	255	7	132
	Tompkins	13	15	3	1	9
	Cortland	160	75	102	14	108
	Broome	131	96	344	9	53
	Madison	353	80	226	4	140
	Onondaga	22	0	0	5	17
	Chenango	960	137	327	9	254
	Oneida	14	0	0	2	14
	Herkimer	83	0	0	1	43
	Otsego	315	130	180	6	230
	Delaware	265	130	130	3	61
	Schoharie	3	0	0	0	0
Susquehanna Basin	**All**	**2552**	**741**	**1584**	**71**	**1063**
Entire New York Chesapeake Basin	**All**	**5,438**	**1,010**	**2,027**	**88**	**1,386**

[1]Number is based on percent of county in the Bay watershed and 2002 Ag Census; may include many small farms or "farms" that are actually land parcels rented to other farmers
[2]Includes AEM Tier 1, 2 and 3a planning projects
[3]Includes AEM Tier1, 2, 3a and 5 planning projects for next 5 years
[4]All CAFOs (includes medium, >200 and large, >700) are dairy except for one 1,000-hog farm in Chemung County and one 1,100-sheep farm in Cortland County

Nutrient Reduction Strategy for Agriculture

The overall strategy is to combine traditional "baseline" county agricultural implementation efforts (i.e., federal and state funded projects that counties will do regardless of Bay restoration needs) augmented with additional "Bay-inspired" projects and new special initiatives. Most activities will have multiple benefits, addressing local and state needs while also providing downstream reductions. County AEM Strategic Plans, the Department's Waterbody Inventory/ Priority Waterbody List, the Susquehanna and Chemung Watershed Restoration and Protection Action Strategy and the USDA Natural Resource Rapid Watershed Assessment identify local priority areas and priority practices.

The USC developed levels of management practice implementation (see table) based on USC SSG meetings with knowledgeable agricultural experts and farmers, **that are believed to be practical and reasonable given sufficient funding, staffing and time necessary for implementation.** These practices include those that have been shown to be highly cost effective in reducing nutrient runoff, such as comprehensive nutrient management plans, so they are clear choices to achieve significant nutrient reduction.

Many of these practices also involve source control or stream protection, so they have local benefits and tend to be fiscally sustainable. In addition, many practices reduce the effects of atmospheric nitrogen deposition by reducing ammonia emissions and/or providing nitrogen retention. Agricultural practices can also be very cost effective because some involve operational changes without major capital commitments.

A cost effective and meaningful watershed approach also relies on a firm understanding of how each watershed functions in relation to its hydrological characteristics, drainage patterns, topography, land cover, land uses and misuses, precipitation events and other parameters. Targeting implementation sites using a "Variable Source Area" (VSA) hydrology concept may further increase success. Details of the VSA concept can be found at this Cornell University website: http://www.bee.cornell.edu/swlab/SoilWaterWeb/research/VSA/index.html. This concept is that a relatively small portion of the watershed influences a majority of runoff exiting a watershed. By implementing practices in these areas, substantial water quality improvements can be accomplished in a more cost effective manner.

Another nutrient concern is nitrogen ammonia, which constitutes about a third of atmospheric deposition, most of which is believed to be emitted from dairy farms. Certain agricultural management practices promoted in this strategy would tend to limit ammonia emissions.

The USC supports management practice planning and implementation on a watershed basis. This approach addresses an issue, such as flooding, streambank erosion, excessive sediment/gravel deposition or degraded fish habitat, at the source (e.g. headwaters), across the landscape and in the stream corridor, as well as programmatically (e.g. regulations/training.) By combining such multiple projects, progress can continue and tangible results can be achieved with even smaller funding levels.

The USC supports planning, education, and implementation solutions for local stakeholders, while also pursuing funds to support local implementation efforts. Multiple barriers increase the probability of success and help capture stakeholder interest by demonstrating tangible progress through implementation. A cost effective and sustainable strategy has multiple components, all of which work together to contribute to local water quality improvements and Bay restoration. The following overview of a "multiple barrier approach" describes the practices and implementation levels suggested by the SSG.

Source Reduction

Source control relies on understanding a farm's nutrient budget. Mass balancing (difference between nutrients entering the farm through feed, fertilizer, fixation etc. and the amount leaving the farm through sales of milk, meat, animals, crops, manure etc.) can determine excess nutrients based on nutrient inputs and outputs. Mass balancing information is useful because it:

- Provides important baseline information for all planning and many implementation projects
- Prioritizes practices where excess nutrients are documented
- Has outreach potential by showing nutrient loading to farmers in a more understandable format
- Demonstrates economic and yield benefits that should attract greater farmer participation
- Can be used to develop a mass balance for a watershed
- Can be used as a tool for documentation if nutrient trading is initiated

The USC and Cornell University are conducting mass balances on 60 farms under a pilot project to streamline how to develop a more extensive application. Because this process is a precursor for precision feeding/forage management and an aid for targeting many management practices, it is a key planning tool. Although Comprehensive Nutrient Management Planning (CNMP) also fits into this category, because of its broader scope, it is discussed under the "implementation across the landscape" heading.

1. Precision Feeding and Forage Management (PFFM)

Nutrient management planning on dairy farms, with a focus on nutrient source reduction, is vital for farm economic sustainability and water quality improvement. Previous studies at Cornell University have reported that 60 to 80 percent of nitrogen and phosphorus imported onto dairy farms remains after accounting for all nutrients that leave. Long-term and sustainable nutrient reduction will occur only by reducing nutrient imbalances, i.e., decreasing imports and/or increasing exports. Significant reductions in nutrient imports can be accomplished with changes in ration formulation, feeding management and forage production and storage practices. This approach increases the efficiency of converting feed into milk. Doing so may increase farm income and decrease nutrient runoff. Not only does "Precision Feeding" help to reduce nutrient runoff, it also reduces volatilized ammonia, an important atmospheric pollutant.

Preliminary research in the neighboring Delaware River Basin indicates that nitrogen and phosphorus intake can be reduced by 15 to 30 percent on dairy farms without affecting milk production. The USC estimates that nutrient excretion can be decreased by 15 to 30 percent and whole farm mass balance by 30 to 40 percent on many dairy farms in the upper Susquehanna watershed through careful feed ration management and maximum use of home grown, high quality forage. The PFFM's source reductions complement other agricultural waste and stream corridor management practices, adding to their nutrient reduction potential.

PFFM requires long-term commitment to an intensive management style to achieve maximum benefits. Financial incentives to overcome the potential for net income loss may be necessary early on. It is imperative that sufficient technical field staff be available to support these specialized farm operations.

The estimate of PFFM practice implementation levels is preliminary, as the USC is just developing its program. The Delaware County Soil and Water Conservation District (SWCD) began a five-farm pilot project in the upper Susquehanna main stem, and the USC and Cornell are initiating a USDA NRCS Conservation Innovation Grant PFFM pilot project on an additional eight farms. This work also will help the CBP meet a priority goal: "to reduce surplus animal manure and poultry litter nutrients by adjusting animal diets." This goal is found in *The Strategy for Managing Surplus Nutrients from Agricultural Animal Manure and Poultry Litter in the Chesapeake Bay Watershed- November 2005*, a Chesapeake Bay Executive Council document endorsed by the USC and signed by the New York State Commissioner of Agriculture and Markets. This manure strategy calls for a 10 percent reduction in nitrogen and phosphorus in dairy manure by 2015. **This goal was used as a preliminary estimate for precision feed and forage management practice implementation, and based on the potential for a decrease of 30 to 40 percent in farm mass balances through PFFM, the USC estimates that PFFM would need to be implemented on 250 farms to reach that goal.**

Implementation Across the Landscape

2. Comprehensive Nutrient Management Plans (CNMP)

CNMPs optimize nutrient use to minimize nutrient loss while maintaining yield. These plans attempt to maximize use of on-farm nutrients such as manure and cover crops and minimize nutrient imports such as purchased fertilizer. In order to sustain nutrient reductions, technical support for plan development, continued plan implementation and regular updates are necessary. Additional staff is required to provide this service, either in the private sector, county SWCD, USDA NRCS or Cornell Cooperative Extension. Three levels of CNMP implementation must be accomplished for complete success:

Plan Development
Agricultural planners generally agree that all farmers should develop and implement sound CNMPs that fit their individual operations. Considerable effort is needed to develop farm specific plans that meet USDA NRCS NY 312 specifications, and some farmers may be reluctant to develop a plan that may call for additional expenditures beyond their means.

Plan Support and Updates
A plan is beneficial only if it is used and kept current. It is important that agricultural planners conduct annual plan reviews with farmers and sample soils when appropriate. Continued planning support is usually overlooked and without it, full nutrient management benefits will not be realized.

Plan Implementation
Complete implementation of nutrient management plans may entail relatively expensive structural components, such as manure storage structures. These structures are typically needed because of long winters in this part of New York. Besides high construction costs, it is a lengthy process to plan, design and build these structures. CNMP implementation may also reduce nutrients imported to the farm by reducing or eliminating phosphorus in starter fertilizer on soils that test high for phosphorus.

The estimate for New York is that comprehensive nutrient management planning could cover 71 percent of all cropland or 303,924 acres. Component practices in CNMPs that receive additional reduction credits are listed separately in the following descriptions of individual practices.

3. Yield Reserve
Nutrient management plan fertilizer recommendations are set approximately 35 percent higher than what a crop needs to ensure nitrogen availability under optimal growing conditions. This yield reserve practice involves setting the nitrogen fertilizer application only 20 percent higher. Because farmers would be accepting some risk in yield, an incentive should be developed to increase participation if this practice shows promise. **Because of the risk to cropland, the Tributary Strategy goal for this practice is set at 1 percent or 1,082 acres. On hay land, where fertilizing has been low historically, the goal is 88 percent or 210,430 acres.**

4. Conservation Plans
Farm conservation plans are a combination of agronomic, management and engineered practices that protect and improve soil productivity and water quality and prevent natural resource deterioration on a farm. Soil conservation plans are comprehensive plans that meet *USDA-NRCS Field Office Technical Guide* criteria. Soil conservation plans help control erosion by modifying operational or structural practices. Operational practices include crop rotations, tillage practices or cover crops and may change from year to year. Structural practices are longer term and include, but are not limited to, grass waterways in areas with concentrated flow, terraces, diversions, sediment basins and drop structures.

Reduction efficiencies are relatively low, with reductions from 3 to 15 percent, depending on the land use type in the plan. **In New York, "Conservation Plans" are usually part of a CNMP. This helps to increase the Tributary Strategy goal for conservation plans, estimated at 88 percent of all farm acreage or 549,976 acres**.

5. Animal Waste Management Systems
These important practices are designed for proper handling, storage and utilization of wastes generated from confined animal operations. They include a means of collecting, scraping or washing wastes and contaminated runoff from confinement areas into appropriately designed waste storage structures. Waste storage structures are typically made of concrete and require continued operation and maintenance, making them a significant cost item. Controlling runoff from roofs, feedlots and "loafing" areas is an integral part of these systems. Scraping or flushing manure more frequently can reduce ammonia emissions from barns and animal confinement areas, as would manure transfer systems that separate feces from urine. Covered manure storage also emits less ammonia. Failure to properly collect and store generated manure may result in losses of liquid manure to surface water and excessive nutrient leachate to groundwater. For dry manure, contact with precipitation or wet soils under stockpiles can result in significant nutrient leaching.

Bay Watershed Model reduction efficiencies for livestock animal waste systems are 100, 100, and 0 percent for nitrogen, phosphorus and sediment, respectively. **When all CNMPs are fully implemented, an estimated 864 farms will need these complete systems, which will almost exclusively be on dairy operations.**

6. Barnyard Runoff Control Practices and Rotational Loafing Lots
These practices may be installed as part of a total animal waste management system or as a stand-alone practice, particularly on smaller operations. Barnyard runoff control practices include diversions, rainwater gutters and similar practices. The rotational loafing lot practice, by proximity, is grouped with barnyard control practices. Reduction efficiencies for barnyard runoff control and rotational loafing lot practices are 100, 100, and 0 percent for nitrogen, phosphorus and sediment, respectively. **The Tributary Strategy goal is to install approximately 861 systems in addition to manure storage structures.**

7. Barn Relocation
Most barns, especially for dairy operations, were built before newer technologies were developed for that industry. Barns may have been built 50 to100 or more years ago. To have drinking water and a means to cool milk, they generally were located near water, often smaller headwater streams. Nutrient loading to streams was not a prevailing concern at the time. Barn location is now an issue because it greatly increases the chance of nutrient runoff and often precludes management practice implementation because there is not enough space.

A new "Barn Relocation" practice should be considered. In some cases, it may be more cost effective and sustainable to relocate a barn rather than to implement many other practices made necessary by the barn's proximity to a stream. Because cost effectiveness and long term sustainability of an operation are important, protocols for a "Barn Relocation" practice will be investigated. **The Bradford County Conservation District in Pennsylvania has piloted this concept by comparing the cost of retrofit practices for a barn to cost sharing a new building and using the old barn for non-animal uses, such as storage. The Tributary Strategy goal is to pilot this concept on 10 farms in the basin where the site, owner willingness and other factors would showcase its mutual and multiple advantages.**

8. Conservation Tillage

Conservation tillage involves planting and growing crops with minimal soil disturbance. It requires two components, (a) a minimum 30 percent residue coverage at the time of planting and (b) a non-inversion tillage method. No-till farming is a form of conservation tillage where the crop is seeded directly into vegetative cover or crop residue. Minimum tillage farming involves some disturbance of the soil, but uses tillage equipment and leaves much of the vegetation cover or crop residue on the surface. Because the climate in New York results in slower spring warm up of soils from continual cover, the ability to implement this practice is reduced. Incentives may be necessary to stimulate use of this practice. **The Tributary Strategy goal is to implement conservation tillage on 36 percent of available cropland or 68,835 acres.**

9. Cereal Cover Crops

Cereal cover crops reduce erosion and nutrients leaching to groundwater or volatilizing, by maintaining a vegetative cover on cropland and holding nutrients within the root zone. This practice involves planting and growing but not harvesting cereal crops, with minimal soil disturbance. The crop is seeded directly into vegetative cover or crop residue and captures nitrogen in its tissue as it grows. When the cover crop is plowed down in spring, trapped nitrogen is released and used by the following crop. Two challenges associated with this practice include difficulty in establishing the crop because of early frost and difficulty in plowing under a heavy crop. Crops capable of nutrient removal include rye, wheat, barley and, to a much lesser extent, oats.

The Bay Watershed Model has no reduction efficiency for legume cover crops such as clover and vetch that fix their own nitrogen from the atmosphere. The model does include a 30 and 7 percent reduction for nitrogen and phosphorus, respectively, for planting cereal cover crops within 7 days after the first frost. **With the proper incentive, the Tributary Strategy goal is to implement cereal cover crops on 61,349 cropland acres.**

10. Commodity Cover Crops

Commodity cover crops differ from cereal cover crops because they may be harvested for grain, hay or silage and they may receive nutrient applications, but only after March 1 of the spring following their establishment. The intent of this practice is to modify normal small grain production practices by eliminating fall and winter fertilization so that crops function similarly to cover crops by scavenging available soil nitrogen for part of their production cycle. This practice can encourage planting of more acreage of cereal grains by providing farmers with the flexibility of planting an inexpensive crop in the fall and delaying the decision to either kill or harvest the crop based on crop prices, silage needs or weather conditions.

Because fertilizer may be applied in the spring, the reduction efficiencies are reduced from cereal cover crop efficiencies. The same planting date criteria apply as specified under cereal cover crops. Reduction efficiencies are 17 percent for nitrogen and 0 percent for phosphorus based on the late planting. **With the proper incentive, the Tributary Strategy goal is to implement commodity cover crops on 22,686 cropland acres.**

11. Land Retirement

Agricultural land retirement takes marginal and highly erosive cropland out of production by establishing permanent vegetative cover such as shrubs, grasses and trees. Wetland construction also could be considered a form of land retirement. USDA NRCS programs such as CRP, CREP and WHIP provide incentives for retirement. Some agricultural land is also going out of production as farms cease to operate. All retired land will be documented. This is especially important because agricultural land, namely cropland, is one of the highest nutrient sources in the Bay Watershed Model, and agricultural land use changes usually result in less nutrient runoff. **Total retirement of agricultural lands is estimated at 18,489 acres.**

12. Wetland Restoration (Agriculture)

Agricultural wetland restoration activities re-establish natural hydrologic conditions that existed prior to installing subsurface or surface drainage. Projects may restore, create or enhance a wetland. Restored wetlands may be any wetland type including forested, scrub-shrub or emergent marsh.

In the Bay Watershed Model, wetland restoration receives a nitrogen reduction efficiency equal to a 60 percent reduction from four upland forest acres, and a phosphorus and sediment reduction efficiency equal to a 60 percent reduction from two upland forest acres. Preliminary results of work by Binghamton University researchers and others show that wetlands capturing high nutrient runoff from barnyards reduce nitrogen concentrations by at least 50 percent. Restored wetlands also provide high quality wildlife habitat.

The USC has an active wetland program that is described in more detail in the Wetland Chapter of this strategy. A total of 4,147 wetland acres have been restored since 1990, most of which were on agricultural lands. The Tributary Strategy goal is create or restore an additional 3,344 acres of wetlands on agricultural lands, including projects funded under USDA Natural Resources Conservation Service's Wetlands Reserve Program.

13. Tree Planting
Tree planting or afforestation (converting agricultural land to forest) includes tree planting on agricultural lands, except those used to establish riparian forest buffers, which is a separate practice. The tree planting practice targets highly erodible lands and critical resource areas.

The Bay Watershed Model treats tree planting as a land use conversion from row crop, pasture or hay land to forest. **The tree planting practice may be sparingly used considering that the New York portion of the Bay watershed is about 70 percent forest. The Tributary Strategy goal is to convert 4,540 agricultural acres to forest with the help of tree planting or preferably through natural succession on voluntarily abandoned agricultural lands.**

Implementation at the Stream Edge

14. Prescribed Grazing
The Prescribed Grazing system objective is to manage forage availability by reducing the time livestock spend grazing on a paddock. Reducing grazing time improves the uniformity of manure and urine deposition over the pasture. The cattle's urine can be taken up by grass, thus lowering ammonia emissions. Grazing also helps to prevent soil erosion, reduce surface runoff and improve forage cover, while using animal manures. Livestock overgrazing and direct access to surface water also are reduced. Specific practices include exterior and interior fencing, laneway development or improvement, pasture seeding or improvement, watering systems (well, pond, spring development), pipelines, water troughs and brush management. Prescribed grazing brings added benefits because some of the grazing practices are associated with other practices, such as livestock exclusion from streams and riparian buffers. A major barrier to overcome with this practice is that switching to grazing can be a major change in operational style. Consequently, this strategy first suggests implementation on existing pasturelands, knowing that additional technical assistance and outreach is needed before broader application will be successful.

Grazing was first initiated in New York through the Grazing Lands Conservation Initiative (GLCI), established in 1991 to provide voluntary high quality technical assistance and awareness of the importance of grazing land resources on private grazing lands. GLCI is a coalition of individuals and organizations functioning at the local, state, regional and national levels. It includes livestock producer organizations, scientific and professional grazing resource organizations, conservation and environmental groups and state and federal natural resource and agricultural agencies. USDA NRCS administers the program.

In 1995, eleven counties in New York were given the opportunity to provide technical assistance to interested livestock producers through the "Graze NY" program. These counties focus their efforts on informing producers about the benefits associated with prescribed grazing. Information is delivered to interested producers through pasture training workshops, informational farm tours, on-site farm visits and personal contacts with interested producers.

Additional grazing initiatives in New York are being supported through the SWCC Agricultural Nonpoint Source Abatement and Control Grants Program. One leader in this initiative is the Finger Lakes Resource Conservation and Development Council that supports work through several grants that cover the entire New York portion of the Bay watershed. Broome and Tompkins County SWCDs also have secured grants to support multiple county grazing projects. Twelve counties in the New York portion of the Bay watershed actively participate in one or more grazing initiatives.

The USC actively supports all such initiatives by tracking progress, providing additional staff support and securing additional funding to maximize implementation efforts. Because of its multiple potential benefits, cost effectiveness and sustainability, prescribed grazing is an important practice to support and promote.

Presently the Bay Watershed Model does not have nutrient or sediment reduction efficiencies for this practice. **Until reduction efficiencies are established for this practice, which could be substantial, the Tributary Strategy goal, with the right incentives, is to implement prescribed grazing, otherwise described as stream fencing with off-stream watering (see 15a below) on 78 percent of pasture acres or 151,751 acres. For cost analysis and modeling purposes, the USC selected 119,325 of pasture acres to be in prescribed grazing.**

15. Stream Protection in Pastures

Direct contact of pastured livestock with surface water results in manure deposition, streambank erosion, re-suspension of streambed sediments and nutrients and aquatic habitat degradation. Stream access also affects herd health by exposure to water borne pathogens and risk of hoof problems. Two practices in the Bay Watershed Model are relevant in New York: (a) off-stream watering with stream fencing and (b) off-stream watering without stream fencing. The practices are mutually exclusive, so reduction efficiencies are not additive.

(a) Off-Stream Watering With Fencing

This practice incorporates fence installation that excludes livestock from narrow strips of land along streams and provides an alternate, clean drinking water source. Fenced areas may be planted with trees or grass but typically are not wide enough to provide the complete nutrient reduction benefits of buffers. Stream fencing should substantially limit livestock access to streams but can allow for hardened crossing areas to access additional pastures or for livestock watering.

The Bay Watershed Model estimates a nutrient reduction on three pasture acres for each 208 feet of stream fencing with reduction efficiencies of 60, 60, and 75 percent for nitrogen, phosphorus and sediment, respectively. Preliminary results from studies in Delaware County show even higher nutrient reductions. By reducing constant stress on stream banks from hooves, cattle exclusion is also a very important practice for stabilizing stream banks. This practice is lumped with prescribed grazing (see 14 above) for a Tributary Strategy goal of 78 percent of pasture acres or 151,751 acres. For cost analysis and modeling purposes, the USC selected 32,426 pasture acres to be simple fencing and off-stream watering.

(b) Off-Stream Watering Without Fencing
This practice requires the use of alternative drinking water troughs or tanks away from streams. To be effective, it should also include shade away from streams for livestock. To be successful, the practice should show reduced livestock manure deposition in and near streams and move heavy traffic areas surrounding water sources to more upland locations. The Bay Watershed Model reduction efficiencies are 30, 30 and 38 percent for nitrogen, phosphorus and sediment, respectively. This practice will be installed where fencing is not feasible or wanted. **The Tributary Strategy goal is to install about 391 systems on an average pasture size of 69 acres.**

16. Buffers (Agriculture)
Besides nutrient reduction value, buffers contribute to habitat improvement. Buffer designs based upon "variable source area" hydrology, which incorporate an analysis of field slopes, drainage patterns and concentrated points of entry at the streambank, are priority projects because they maximize water quality benefits. The SWCC Agricultural Nonpoint Source Abatement and Control Grants Program scoring system gives added priority to buffers.

(a) Agricultural Riparian Forest Buffers are linear wooded areas along rivers, streams and shorelines. Forest buffers help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. This practice meets some resistance by farmers because of the loss of cropland, added expense of tree planting, maintenance and potential to shade crops. A graded approach that changes from trees at the water edge to shrubs near the crops provides maximum benefits while reducing farmer concerns of shading. The CBP recommends a buffer width for riparian forest buffers (agriculture) of 100 feet, yet a 35-foot minimum (NRCS criteria) width is required to obtain reduction in the Bay Watershed Model. For New York, this practice reduces nitrogen by 60 percent on four upland acres and reduces phosphorus and sediment by 60 percent on two upland acres. **The Tributary Strategy goal is to install approximately 5,765 acres of forested buffers.**

(b) Agricultural Riparian Grass Buffers are linear strips of grass or other non-woody vegetation maintained between the edges of fields and streams or rivers that help filter nutrients and sediment and improve habitat. The recommended buffer width is the same as riparian forest buffers. This practice has tremendous potential and would be more widely used if it were eligible for CREP funding on more than just cropland and if the grown on the buffer could be cut and used. A "natural regeneration" buffer that could ultimately revert to forest also has tremendous potential. This practice is slightly less efficient in the Bay Watershed Model than forested buffers, reducing nitrogen by 41 percent on four upland acres and reducing phosphorus and sediment by 60 percent on two upland acres. **The Tributary Strategy goal is to install approximately 5,574 acres of grass buffers.**

17. Alternative Manure Uses (Including Energy Production and Composting)
Although energy production does not reduce nutrients, using manure biodigesters to generate heat or electricity provides a new funding source to help farmers meet other nutrient reducing obligations. It can also produce more manageable manure byproducts that can more easily replace imported purchased fertilizer. As described in "Precision Feeding," New York will support alternate uses of manure found in *The Strategy for Managing Surplus Nutrients from Agricultural Animal Manure and Poultry Litter in the Chesapeake Bay Watershed - November 2005*. Additional income will help keep farms viable, thus protecting open space, food production and good land stewardship. **A Tributary Strategy goal has not been set for these practices. The USC will collect information on these practices as it becomes available.**

18. Carbon Sequestration
The long-term storage of carbon through the planting of carbon sinks, such as trees is being considered by the CBP as a practice to incorporate into the Bay Watershed Model. **This practice may become more important in the future because Regional Greenhouse Gas Initiative allows it as an emission off-set.**

Programmatic Approach – Regulatory Reductions through CAFO Requirements

Additional reductions will be documented on CAFO farms that must meet permit requirements through various management practices described in their individual comprehensive nutrient management plans. New York CAFO regulatory requirements are found in State Pollutant Discharge Elimination System (SPDES) General Permit GP-04-02, which may be viewed on the DEC website at http://www.dec.ny.gov/docs/water_pdf/gp0402permit.pdf. One essential permit requirement is for all CAFOs to have no discharge of process wastes or contaminated runoff from the CAFO area, except under extreme precipitation events. All CAFOS must develop and implement comprehensive nutrient management plans, which are developed or reviewed by AEM certified planners. For large dairy CAFOs, the compliance date to implement all practices is December 31, 2006. For medium dairy CAFOs, compliance dates are: October 1, 2007 for non-structural practices, October 1, 2008 for high risk conditions and June 30, 2009 for all practices.

Of the 88 CAFOs in this region, 2 are large. Altogether, CAFOs cover about 28 percent of the dairy herd and about 2 percent of farm sites and will result in significant amounts of management practice implementation and oversight. However, due to the magnitude of the Tributary Strategy goals for phosphorus and nitrogen, there is still an important need for implementation on the numerous smaller, non-CAFO farms.

Table 6. Practice	Cost per unit to set up	Yearly Costs to maintain	Available units	BMPs previously installed (acres or systems)	Practical and reasonable Implementation levels as suggested by USC	Total Set Up Cost (minus BMPs already installed)	Total Yearly Maintenance Cost
1. Precision Feeding and Forage Management	$30,000	$10,000	16 m N 2.8m P	0	1.6m N (on 250 farms), 0.28 m P	$7,500,000	$2,500,000
2. Comprehensive Nutrient Management Plans	$22/ acre	$3/acre	424,024 acres	63,978 acres	303,924 acres (includes hayland)	$5,278,812	S911,772
3a. Yield Reserve – cropland	na	$40/acre		0	1,082 acres	na	$43,280
3b. Yield Reserve – hayland	na	na		0	200,000 acres	na	0
4. Conservation Plans	In CNMP	Included in CNMP	614,381 acres	56,372 acres	549,976 acres	na	na
5. Animal Waste Management Systems – storage	$200,000/ farm	S4,000/ system	1400 dairy farms	248	864	$123,200,000	$3,456,000
6. Barnyard Runoff Controls or rotational loafing lots	$35,000/ farm	$45/ system	1400 dairy farms	191	861	$23,450,000	$38,745
7 Barn Relocation	$100,000/ barn	na	Unknown	0	10 barns	$1,000,000	na
8. Conservation Tillage	$60/acre	$3/acre	188,937 acres	15,992 acres	68,835	$3,170,580	S206,505
9. Cereal Cover Crops	na	$40/acre	187,594	0 acres	61,349 acres	na	$2,453,960
10. Commodity Cover Crops	na	$40/acre	187,594	0 acres	22,686 acres	na	S907,440
11. Land Retirement	$928/ acre	na	55,400	5,424	18,489	$12,124,320	na
12. Wetland Restoration	$4,317	1%	31,000	4,147	7,491	$14,436,048	S144,360
13. Tree Planting	$615/ acre	$2.21/acre	41,900	1,591 acres	4,540 acres	$1,813,635	$10,033
14. Prescribed Grazing	S253/acre	5%	194,711 acres	17,278 acres	119,325 acres	$25,817,891	$1,509,461
15a. Stream Protection w/fencing and off-stream watering	22,950/ mile	$158/mile		8,379 acres or 164 miles of stream fence	32,426 acres or 636 miles of stream fence	$10,832,400	S100,488
15b. Stream Protection through off-stream watering	$6,750/ system	$5.20/ system		384 acres or 6 systems	27,000 acres or 391 systems	$2,598,750	$2,033
16a. Riparian Forest Buffers	$1000/acre	$10/acre	43,876 acres	2,637 acres	8,402 acres	$5,765,000	$84,020
16b. Riparian Grass Buffers	S175/acre	$8.75/acre	43,043 acres	2,704 acres	8,278 acres	$975,450	$72,433
17. Alternative manure uses	0	0	0	0	Placeholder	0	0
18. Carbon Sequestration	0	0	0	0	Placeholder	0	0
TOTAL	na	na	Na	na	Na	$237,962,886	$12,440,530

1. Precision Feeding and Forage Management - Estimates will be developed as part of a NRCS CIG grant. An early rough estimate is $30,000 to establish a precision feeding program on a farm and $10,000/year maintenance cost.
2. Comprehensive Nutrient Management Plans – Cost based on estimates from 2004 NYS Department of Agriculture and Markets grant
3. Yield Reserve - Cost based on Chesapeake Bay Commission estimate for cropland only = $30/acre farmer incentive, $8.50/acre insurance, $1.50/acre technical; hayland cost negligible.
4. Conservation Plans - Acreage available is based on total cropland, hayland and pasture in the watershed.
5. Animal Waste Management Systems (storage) Maintenance estimated at 2 percent based on NRCS EQIP Ranking Tool Average Cost Calculator. Note that the CBP assumes 877 dairy farms, each with 145 cows, compared to the 1,400 dairies counted by the USC in NY that range from about 25 to 2,500 animals.
6. Barnyard Runoff Controls or Rotational Loafing Lots - Maintenance estimated is $45/project per NY NRCS (filter strip = $12, drip line or gutter, average $33). Note that the CBP assumes 877 dairy farms, each with 145 cows, compared to the 1,400 dairies counted by the USC that range from about 25 to 2,500 animals.
7. Barn Relocation - A suggested pilot.
8. Conservation Tillage - Cost based on CBC estimate of $15/acre/year for 4 years as incentive to promote practice and $3/year operating cost.
9, 10. Cereal and Commodity Cover Crops - Based on $40/acre Maryland estimate.
11. Land Retirement - $928/acre is the Virginia estimate. Land retirement includes land retired under an incentives program such as CRP, as well as land retired because farming ceased.
12. Wetland Restoration - This table includes only wetlands on agricultural lands; the entire wetlands initiative is described in the separate wetlands chapter. The USC wetland program estimate is installation $3,817/acre and planning/technical assistance $500/acre. Maintenance estimated at 1 percent based on NRCS EQIP Ranking Tool Average Cost Calculator.
13. Tree Planting - Uses MD estimate of $615/acre. Maintenance is estimated at $2.21/acre per NY NRCS.
14. Prescribed Grazing - Based on 38 farms fully implemented in prescribed grazing, covering 2,060 acres the cost was $521,400, averaging $253/acre. Maintenance estimated at 5 percent based on NRCS EQIP Ranking Tool Average Cost Calculator.

15a. Stream Protection w/ fencing and off-stream watering - An analysis of pasture in NY revealed an average of 18 feet of stream per acre of pasture. Using this statistic, costs per mile of implementation are assumed to be $2.50/ft for fencing ($6,230,400), a $750 trough every 1/5 mile ($1,770,000) and one $6,000 water source development/mile ($2,832,000). Maintenance is estimated at .03/ft per NY NRCS. These cost estimates are discounted by 50 percent with the assumption that half of this BMP will be installed as part of prescribed grazing project (#8).

15b. Stream Protection through Off-Stream Watering - Estimate is based on one trough ($750) and one water source development ($6,000) for a 45-acre pasture, which is the assumed size. Maintenance is estimated using $5.20/spring development per NY NRCS.

16a. Riparian Forest Buffers - Cost is based on MD estimate of $1,000/acre. Maintenance estimated at 1 percent based on NRCS EQIP Ranking Tool Average Cost Calculator.

16b. Riparian Grass Buffers - Cost is based on VA estimate of $175/acre. Maintenance estimated at 5 percent based on NRCS EQIP Ranking Tool Average Cost Calculator.

17. Alternative Manure Uses (Including Energy Production and Composting) - placeholder
18. Carbon Sequestration – placeholder (without any implementation planned until more information is collected.)

Funding the AEM Program in the NY CB Watershed

Since 1994, the New York State SWCC Agricultural Nonpoint Source Abatement and Control Grant Program, has allocated cost-share funds from the New York State Environmental Protection Fund to support farmers' efforts to protect water quality and natural resources that are in the public's interest. These funds, along with Federal Farm Bill funds have provided almost all of the agricultural implementation in this watershed. There is virtually no dedicated funding stream for agriculture in this watershed for the estimated $238 million needed to implement all practices suggested in this strategy (See Table). Funds are usually obtained from competitive grants. The following list includes all agricultural partners and comprises the majority of funding sources for agricultural planning and implementation:

- Landowner funded implementation projects and cost-share contributions
- New York State SWCC Agricultural Nonpoint Source Abatement and Control Grant Program using NY Environmental Protection Funds. State fiscal year 2005/2006 funds were $6.7 million and $11 million was awarded in 2006/2007. The 2007/2008 state budget includes $12.8 million. These numbers are statewide total and subject to a competitive grant program.
- NYS Environmental Facilities Corporation "EFarm Program," reimbursement for CNMP development and annual updates
- USDA NRCS Farm Bill Programs, including EQIP, WRP, AMA and others
- USDA FSA Farm Bill Programs, including CRP and the NY CREP
- Special congressional earmarks, such as those supporting the AEM planning through the NYS DAM and prescribed grazing under the Graze NY and GLCI programs
- Special grants obtained through RFPs, such as the USDA NRCS Conservation Innovative Grants and the EPA Targeted Watershed Initiative

A dedicated funding source would help to provide long-term stability and AEM capacity directed at the most significant nutrient and sediment reduction component in this Tributary Strategy, namely agriculture.

Meeting the Tributary Strategy Goals

At present, including all the previously installed management practices the USC has been able to document, the Bay Watershed Model predicts that agriculture in New York generates about 12,093,316 pounds of nitrogen and 953,538 pounds of phosphorus. With all of the management practices suggested for implementation in this Tributary Strategy that are practicable and reasonable, the model predicts the nitrogen and phosphorus generation will be reduced to 7,978,646 and 588,068 pounds, respectively.

The USC believes that with Model version 5 assumptions and data inputs the agricultural goals will be attained or exceeded. Changes include development of a reduction credit for prescribed grazing, better estimates of both dairy cow and beef cattle numbers, reanalysis of dairy cow weights, reanalysis of beef farm contributions, reformulation of CNMP reduction credit, additional credit for nitrogen loss in headwater streams, readjustment of agricultural acres and better estimates of purchased fertilizer and analysis of fertilizer use, especially on hay land.

Forests and Atmospheric Deposition

Background

Forests in the New York portion of the Chesapeake Bay watershed cover about 2.8 million acres or about 71 percent of the watershed. It has been estimated that these forests contribute approximately 26 percent of New York's total nitrogen (N) load and only 0.03 percent of the total phosphorus load. This pollution comes from sources outside of New York and may be difficult to control. The location of the forest with respect to atmospheric deposition and hydrological pathways is important. Much of the New York forest is located at high elevation where N deposition is greatest (Ollinger, et al., 1993). Because N leaching from forested watersheds represents a significant portion of New York's nutrient export, it is critical to document the benefits of reducing atmospheric deposition, as well as properly managing these lands to meet the nutrient Tributary Strategy goals.

Although N fixation accounts for a portion of the N cycling through forested ecosystems, most N is deposited atmospherically in the form of wet and dry particles (Galloway, et al., 2003). Of this deposition, about two-thirds are oxides of nitrogen (originating from car exhaust and power plants); one-fifth is deposited in a reduced form (ammonia from volatilization of animal manure), and the remainder is organic nitrogen (from vegetation.)

Nitrogen in Forests

In the temperate climates of North America, all land uses average a 20 percent export of anthropogenic N to coastal regions, while the remaining 80 percent is stored or denitrified through a microbial process where nitrate is converted to dinitrogen gas (Howarth, et al., 2002). While most of the nitrogen that falls on impervious surfaces flows directly with runoff to streams, nitrogen deposition on less impervious areas may be stored in soil organic matter where it can be taken up by vegetation and cycle through the ecosystem (Zak, et al., 2004). Retention of nitrogen by forests is a non-linear function of deposition. Elevated rates of atmospheric N deposition in forested catchments of northeastern United States can result in what is know as N saturation.

Nitrogen saturation is defined as the availability of reactive forms of N in excess of total combined plant and microbial nutritional demand (Aber, et al., 1989). This may result in increased nitrate losses to nearby streams, rivers, and lakes. Forested catchments receiving up to about 10 kg N per ha per year (about 9 lbs N per acre per year) retain up to 90 percent of the deposited nitrogen; however, with higher nitrogen deposition, retention can vary depending on many forest characteristics such as species composition, land use history, soil carbon to nitrogen ratios, geology and hydrologic flowpaths (Burns, et al., 1998; Goodale and Aber, 2001; Lovett, et al., 2002). In forests receiving elevated rates of nitrogen deposition, a 1 kg N per ha^{-1} yr^{-1} reduction in deposition may result in a 0.85 kg N ha^{-1} yr^{-1} reduction in export to streams (Aber, et al., 2003). Because atmospheric deposition to these watersheds generally exceeds 10 kg N ha^{-1} yr^{-1}, nitrate export would be highly responsive to reductions in atmospheric N deposition.

The nitrogen yield from forests also varies seasonally. Surface water nitrate concentrations generally peak during snowmelt and are lowest during the growing season, when biotic uptake and denitrification are greatest (Aber, et al., 2003; Zhang and Zhu, 2004). The snowmelt and subsequent saturated soils also yield the most runoff (March through May), which account for about half of the nitrogen yield from forested ecosystems.

The age of a tree affects N consumption and hypothetically, an intermediate-aged successional forest should retain more N than a mature forest (Vitousek and Reiners, 1975). Thus, a periodic reversion of a forest to an aggrading stage through logging or wildfire may result in additional N retention (Howarth et al., 2002; Goodale and Aber, 2001). However, care must be taken because intensive forest harvesting, especially in areas of high N deposition, can increase the export of nitrate to streams at least during the first two or three years after the harvest (Aber, et al., 2002; Burns and Murdoch, 2005). Because nitrification is an acidifying process (Driscoll and Schaefer, 1989) this can result in lower stream water pH, less acid neutralizing capacity and mobilization of toxic aluminum and base cations from forest soils (Hornbeck, et al., 1986; Martin, et al., 2000).

Because forested watersheds undergo some harvesting, it is critical that a forest management program incorporates treatments that maximize tree nutrient uptake while minimizing nutrient losses. As mentioned previously, N retention can be increased by maintaining forested lands in an intermediate-aged successional stage. By selection for uneven-aged stands through partial harvests, forests can be managed to maintain an elevated nutrient demand while achieving limited nutrient losses. Recent evidence on the effects of forest harvesting on stream chemistry indicate that partial cuts result in much lower nutrient export to streams when compared to intensive harvests (Bäumler and Zech, 1999; Wheeler, et al., 2000; Wang, et al., 2006). It has been hypothesized that the remaining vegetation retains much of the N that otherwise could have been lost following disturbance.

Forest harvesting operations can remove base cations from the forest floor, which can reduce soil fertility (Federer, et al., 1989). Soil nutrient deficiencies can be detrimental to the ecosystem and hinder the potential for forests to sequester N. To avoid negative effects, forests in New York's Chesapeake Bay Watershed need to be managed with appropriate rotations to avoid high grading and excessive removal of trees that can negatively affect the ecosystem and nutrient retention. It is also important to understand that management of forested ecosystems should by no means become the only solution for an atmospheric N deposition problem. Harvesting forests should not become a replacement for reducing N emissions from anthropogenic activities.

Other Open Space
Included with the forest is other open space that Version 4.3 of the watershed model lists as a "mixed open" category. The model uses the "mixed open" category to account for differences between estimates for forest and urban land use estimated by one method and agricultural land estimated by another method. The load attributed to this land use in Bay Watershed Model Version 4.3 is largely from fertilizer applications. In the next version of this model, this land will be reassigned to other more specific land uses. Much of this land in the New York portion of the Bay watershed is believed to be old farm fields that are reverting to brush land and emergent forests, and thus no longer receive fertilizer applications. In addition, as discussed in the chapter "Information Needs for the Bay Watershed Model," these aggrading transitional forest lands are likely to retain more nitrogen than the typical forest, which would lower the N yield that has been estimated by the current model, even for forest land use.

Forestry Management Practices
Because forest cover in the watershed is so extensive, good logging practices and other related management practices to minimize sediment and nutrient loading are of great importance. A discussion of management practices can be found at these websites: http://www.dec.ny.gov/lands/5240.html and http://www.nyc watershed.org/clw_logger.html. Chemung County Soil and Water Conservation District also developed a logger training manual. The USC will work toward understanding the potential sediment contribution from forest harvesting operations while supporting management practices and training.

A potential management practice being developed to retain nitrogen involves chipping some of the slash (logs and branches smaller than nine-inch diameter) typically left behind after logging. Wood chips left on the forest floor provide a source of carbon to soil microbes, stimulating nitrogen retention. The procedure has been shown to reduce nitrogen losses by approximately 30 percent for the first year after harvesting (Homyak, 2006). Because the research is relatively new and limited, a management practice efficiency for use in the Bay Watershed Model has yet to be determined. Also, more needs to be understood of the practical ramifications, including cost and property owner acceptance, as well as the overall effect on the forest ecosystem and natural resources.

Impact of Future Reductions in Atmospheric Deposition
Because the forest category (including other open space) represents the largest source of nitrogen, some future reductions are needed in this tributary strategy to meet the overall cap load for New York State in a cost effective manner. As discussed in the paragraph above, promising practices may increase the forest potential to uptake or denitrify atmospheric deposition. Because a forest management practice is not available in the Bay Watershed Model, this strategy estimates the potential nitrogen load reductions associated with reductions in atmospheric deposition.

The CBP allocation to New York in 2003 accounted for some reductions that were projected from the EPA's Clear Skies Initiative. Since 2003, there have been federal and state regulations, and initiatives that would likely result in additional reductions of nitrogen emissions. Although model quantification of these reductions is not available at this time, this strategy estimates the associated emission reductions to result in approximately 18 percent reduction of nitrogen load from forest lands.

Because Congress did not adopt the Clear Skies Initiative, the EPA promulgated the Clean Air Interstate Rule (CAIR) to meet the requirements of the Clean Air Act (CAA). CAIR requires substantial reductions in oxides of nitrogen from power plants and other stationary sources. The EPA estimates that CAIR will result in significantly less nitrogen being delivered to the Chesapeake Bay than would have been achieved through the Clear Skies Initiative. A new air dispersion model shows that the greatest reductions would be in the New York portion of the watershed.

Partly because CAIR does not address all sources, such as automobile emission, substantial metropolitan areas in the northeastern United States still will not meet all CAA air quality standards. Consequently, New York and other upwind states will be required to develop State Implementation Plans (SIPs) to address all emission sources of oxides of nitrogen, which will have a side benefit of even further reductions of atmospheric nitrogen deposition.

New York has already undertaken significant actions, including the following:

- Adoption of year-round NO_x controls at power plants. Because nitrogen deposition during cold weather months is most likely to result in nitrogen losses to runoff, for reasons described above, this control will likely have the most significant effect.

- Adoption of the low-emission-vehicle (LEV) standards for nitrogen oxides.

- The Regional Greenhouse Gas Initiative (RGGI), under which seven northeast states, including New York and Delaware, have agreed to implement a cap-and-trade program to lower CO_2 emissions. This is the first such mandatory program in United States history. The RGGI allows carbon offsets, including sequestration of carbon due to afforestation and avoided methane emissions from agricultural manure management operations. Thus, the RGGI may provide resources through offset mechanisms to increase practices that support implementation of this strategy.

- Renewable Energy Portfolio Standard, which targets renewable energy as 25 percent of the electrical energy sold at retail in New York State by 2013. A Public Service Commission order authorized funds collected by utilities be used to help renewable energy projects get financing. Examples of projects under review within the Susquehanna/Chemung basins include more than 300 MW of wind power. The Renewable Portfolio Standard may also financially support farm digester production of methane and electrical generation.

- In 2005, the New York State Environmental Board approved state regulations that require significant reductions in greenhouse gas emissions from motor vehicles (LEV for carbon dioxide).

It is difficult to directly quantify the nitrogen reduction benefits of the last three initiatives, but they are likely to reduce nitrogen emissions by reducing fossil fuel consumption.

Ammonia from Agriculture

Up to a third of atmospheric nitrogen deposition may be attributable to ammonia volatilization from agricultural sources. Although the agricultural management practices suggested in this strategy target nutrient reductions, many act to also reduce ammonia volatilization and subsequent deposition. These include precision feed/forage management, improved nutrient balance, cover crops and barnyard runoff controls, such as more frequent scraping and flushing, with covered manure storage. When selecting practices to reduce nutrient runoff through voluntary AEM participation, these and other management practices to limit ammonia losses from farms will be considered. In addition, the EPA is reviewing the need to promulgate federal regulations controlling large, concentrated ammonia emissions.

The ammonia reductions from agriculture might be smaller in scope than the initiatives to reduce oxides of nitrogen from power plants and automobile exhaust, but could have more local effect on atmospheric deposition. Existing ammonia emissions from farmsteads and fields are primarily at ground level and tend to be concentrated within valleys where deposition can be on adjacent forested ridgelines.

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Wastewater

Background

The wastewater strategy offers a practical approach to help conserve and protect water quality in the upper Susquehanna watershed in New York and to work toward removing the Chesapeake Bay and its tidal tributaries from the federal 303(d) impaired waters list. It builds from ongoing and successful efforts to maintain compliance with New York water quality standards and Environmental Conservation Law and from a strong local water stewardship ethic in New York.

The wastewater strategy recognizes that nutrient removal from wastewater treatment plants (WWTP) is generally cost effective and reliable. Because current funding streams are insufficient to accomplish all of the additional nutrient reduction that is expected, a plan to establish a cost-effective priority for WWTP upgrades is provided. Although the wastewater strategy is not a precursor or forecast of wasteload allocations found in a total maximum daily load (TMDL), it does help to prepare for wasteload allocations should a TMDL for the Bay watershed become necessary.

Current Bay restoration needs are based upon Bay Watershed Model Version 4.3 which was not based upon nutrient monitoring at New York WWTPs. Accordingly, this strategy is likely to be revised after Watershed Model Version 5.0 is completed in early 2008 and additional monitoring data is collected. This strategy may also be revised to meet potential funding source or New York water program needs, such as the development of numerical nutrient standards for flowing waters in New York that is now underway.

With support from a local, state and federal partnership, the largest discharge in the New York portion of the Bay watershed, the Binghamton-Johnson City WWTP, completed construction of enhanced nutrient removal treatment in July 2007. This project also will reduce combined sewer overflows. In 2006, this discharge accounted for about 30 percent of the nitrogen from WWTPs from New York. Promoting similar partnership opportunities at other large WWTPs is central to this strategy.

This strategy focuses on reducing nutrients from municipal WWTPs permitted to discharge more than 400,000 gpd and industrial WWTPs with an equivalent nutrient discharge of 3,800 pounds per year phosphorus and 27,000 pounds per year nitrogen. Discharge information for the 28 WWTPs that meet this criteria is found at the end of this section. Of the 28 significant Bay discharges, 26 are municipal and 2 are industrial. Five are between 9 and 20 mgd, 7 are between 1 and 9 mgd and 16 are less than 1 mgd. This strategy also identifies reduction actions from smaller, non-significant WWTPs.

Throughout this Tributary Strategy, source controls are promoted, recognizing their overall cost effectiveness and long term reduction value. In this regard, the wastewater strategy identifies the value of seeking to extend the phosphate ban on household cleaning products to include automatic dishwasher detergent. Other waste stream nutrient reductions also will be examined.

The wastewater strategy treats phosphorus and nitrogen separately. Because WWTPs contribute a higher fraction of New York's phosphorus load (about 26 percent in 2006), it will be difficult to achieve the phosphorus Tributary Strategy goal without phosphorus reduction from all significant WWTPs. Phosphorus also has a greater effect on local water quality and in the northern portion of the Chesapeake Bay. For these reasons, the wastewater strategy recognizes the overall significance of phosphorus reductions. On the other hand, because WWTPs contribute a smaller fraction of New York's nitrogen load (about 12 percent in 2006), it is possible to achieve the nitrogen Tributary Strategy goal without nitrogen reduction at each significant WWTP.

The Tributary Strategy goals for wastewater are about 2.3 million pounds/year (mp/yr) total nitrogen (TN) and about 0.23 mp/yr total phosphorus (TP); 2.1 mp/yr TN and 0.21 mp/yr TP is reserved for significant discharges. The remaining 10 percent is reserved for non-significant discharges. Current estimates of nutrient loads from non-significant discharges are well below this amount. Accordingly, at the present time nutrient reductions from non-significant discharges are encouraged but not expected. For example, the new non-significant municipal WWTP for Whitney Point has a permit TN limit of 8 mg/l. If a non-significant WWTP were to exceed the 10 percent reserved, offsets or other means to reconcile the new discharge will be identified.

Because the record of monitored nutrient discharge data from the significant WWTPs is short, a stepped approach to nutrient reduction planning is necessary. All significant SPDES permits will include nutrient limits, first in the form of action levels, which act to "cap" current discharges at design flows and optimize performance within current treatment schemes. Then, as capital upgrades occur for specific additional nutrient removal treatment, final effluent limits will be assigned commensurate with the level of treatment constructed, as is the case for the Binghamton - Johnson City WWTP upgrade. Because not every significant discharge is expected to need additional nitrogen reduction treatment, it is necessary to identify the most cost-effective opportunities. A general priority is placed on nitrogen upgrades at the smaller number of significantly larger WWTPs located closer to the Bay.

The wastewater strategy is divided into four levels, representing increased effort and understanding and potential changes to the current regulatory framework, such as a Bay watershed TMDL or new New York water quality nutrient standards. It begins with significant reductions that are achievable without large capital expenditures and ends with establishing priority for such upgrades should sufficient funding become available for more widespread WWTP upgrades, considering uncertainty with the CBP re-evaluation of "Cap Load Allocations" in 2009.

Level One is the starting point and includes establishing an accurate nutrient discharge load and ensuring compliance with existing water quality program regulations. Such regulations are found in *New York Codes, Rules and Regulations* Title 6, Chapter 10, Part 750. These actions are necessary to establish the baseline needed to further identify cost-effective nutrient reduction upgrades. In addition, as with the Binghamton - Johnson City WWTP, identifying upgrade opportunities that achieve both local and Bay water quality objectives remain a high priority.

Nutrient monitoring data collected since all Bay significant SPDES permits were modified in spring 2005 reveals, in aggregate, lower nutrient concentrations than the CBP used for model data input in 2004. The new monitoring data, coupled with expected reduction from the Binghamton - Johnson city WWTP upgrade, shows about 1,500,000 pounds less nitrogen than 2004 model predictions. This is about two-thirds of the overall nitrogen reduction needed to meet the wastewater Tributary Strategy goal. Similarly, phosphorus is predicted to be about 175,000 pounds less or about one-half of the overall reduction expected.

Preliminary engineering assessments at 11 of the significant WWTPs reveal relatively large variation in nutrient removal costs and overall costs substantially higher than Chesapeake Bay Program estimates. For discharge levels of 5.0 mg/l nitrogen and 0.5 mg/l phosphorus, the nitrogen removal cost ranged from $4-22/pound and for phosphorus, from $6-25/pound. The 20-year total cost is about $200 million compared to $114 million for 18 WWTP upgrades used by the CBP during its "Cap Load Allocation" process. These new preliminary assessments and the new monitoring data suggest further optimization of nutrient removal is feasible, particularly at plants that already nitrify. Through the action level/optimization process described below, additional insight into cost-effective major capital upgrades will be gained.

The **Level Two** objective is to establish nutrient action level concentration limits in significant Bay WWTP permits. Action levels will be based on current performance after sufficient monitoring data is gathered. For WWTPs with action levels at or below 12 mg/l TN and 2.0 mg/l TP, the permit will require corrective action to return performance below the action level. For facilities with higher action level concentrations, the permit will require such permittees to investigate and implement actions to optimize nutrient removal, including minor treatment modifications, and seek other potential nutrient source reductions. In addition, as a supplement to existing preliminary engineering assessments or conducting initial assessments, such permittees will be asked to identify cost-effective strategies within a specified time frame to achieve greater levels of treatment, considering a range of effluent nutrient concentrations down to the limits of the best technology available.

Major capital upgrades to significant Bay WWTPs may occur only as time and available funding allow. Accordingly, the **Level Three** goal is to establish a priority for potential wwtp capital improvements, should additional funding become available, based upon multiple objectives. These include local water quality impairment, existing infrastructure deficiency, nutrient removal cost efficiency and overall potential to reduce nutrients delivered to the Bay, considering both load reduction magnitude and attenuation factors. The receiving water size and proximity to the Bay have a significant influence, particularly for nitrogen attenuation.

The wastewater strategy will not develop facility specific waste load allocations. It is impractical at this time because sufficient WWTP baseline information does not exist and the Bay Watershed Model refinements and CBP "Cap Load Allocation" re-evaluation processes are not completed. Because New York WWTPs are relatively small contributors, particularly for nitrogen, even small changes to overall "Cap Load Allocations" can have a large impact on the wastewater strategy. **Level Four** is essentially a placeholder to institute individual or grouped wasteload allocations at a future date as necessary per USEPA approved Chesapeake Bay watershed-wide TMDL or to achieve New York water quality standards.

The following are more detailed descriptions of the wastewater strategy levels:

Level One: Develop and initiate a process to provide accurate discharge data and enhanced regulatory oversight, with emphasis on nutrient reduction. Seek nutrient removal capital upgrades at significant facilities through local/state/federal partnerships. Time frame - Ongoing

Significant Bay Wastewater Treatment Plants (WWTP)(permit/design flow is >400,000 gpd)

- Continue to collect WWTP discharge load data from significant Bay WWTPs made possible by the April/May 2005 SPDES permit monitoring modifications.

  - Ensure representative sampling procedures in accordance with 6NYCRR Part 750-2.5(a)(2).

  - Ensure accurate flow measurement in accordance with 750-2.5(a)(5).

- Report significant Bay discharge data and bio-solids disposal summaries to the Chesapeake Bay Program annually and in a timely manner.

- For existing significant Bay WWTPs that expand, at a minimum, and commensurate with the intent of DEC Technical and Operation Guidance Series (TOGS) 1.3.6 (*Phosphorus Removal Requirements for Wastewater Discharges to Lakes and Lake Watersheds*), no increase in phosphorus load should be permitted. An analogous approach for nitrogen should be considered. However, since expansion will, in all likelihood, require some treatment modification or capital improvement, the strategy is to strive to incorporate a high level of nutrient removal treatment similar to the Binghamton-Johnson City WWTP example. Again, new load attributable to growth is likely to be within the 10 percent reserved for non-significant discharges.

- Following the Binghamton-Johnson City WWTP example, seek to identify additional opportunities to address deficiencies at significant Bay WWTPs where there is funding for nitrogen and/or phosphorus removal, using:

  - DEC Division of Water Integrated Compliance Strategy System to identify WWTP deficiencies

  - Existing engineering assessments and supplements to identify cost-effective nutrient removal options

- Congressional and/or state appropriations and/or other grant/loan opportunities to help fund major capital upgrades and the addition of nutrient removal treatment

- The greatest treatment level that is reliable and energy efficient

- For new significant Bay WWTPs, the nutrient treatment level goal is 0.5 mg/l total phosphorus (TP) and 5.0 mg/l total nitrogen (TN). Although new significant discharges are not expected, other than through consolidation, such new nutrient load will be accounted for in future TMDL development. New load attributable to growth is likely to be within the 10 percent reserved for non-significant discharges.

Bay Non Significant/General Permits

- Determine universe of wastewater permits and regularly maintain a list.

- Ensure wastewater discharges are appropriately managed or permitted in accordance with TOGS 1.4.1 (*Integrated Compliance Strategy System*), particularly discharges containing nutrients, including but not limited to private, commercial and institutional sewage treatment, landfills, food and beverage manufacturers and water treatment plants. Also, ensure wastewater discharges outside the SPDES program, such as groundwater remediation sites, are controlled to prevent high concentrations of nitrate or phosphorus from being pumped directly to surface waters.

- Dedicate sufficient resources to ensure compliance with emerging general permit programs, including concentrated animal feeding operations, municipal separate storm sewer systems, construction stormwater and industrial stormwater.

- For new and expanded non-significant wwtp permits, ensure phosphorus TOGS 1.3.6 is reviewed and that the Chesapeake Bay impairment is a considered component. When funding opportunity allows, especially when water quality-based effluent limits foster cost efficiencies, seek to include nutrient removal treatment, particularly for surface discharges greater than 50,000 gpd, such as the Village of Whitney Point new community collection and treatment system plan example.

Source Controls

- The DEC shall promote phosphorus source control by seeking to extend the phosphate ban on household cleaning products to include automatic dishwashing detergent.

- Accomplish additional load reduction by seeking alternate WWTP discharge locations and/or opportunities for effluent re-use, such as wetland enhancement and irrigation.

- The DEC shall ensure nutrient loads to and from significant Bay WWTPs and/or collection systems are minimized by establishing a permanent intra-agency watershed regulatory oversight coordinating committee to meet regularly, with emphasis on the following:

  - Excessive inflow/infiltration is removed to an extent that is economically feasible (750- 29(a)(3).

  - Wet weather operations plans minimize discharges of untreated or partially treated wastewater (750-2.8(b)(1)).

  - WWTPs have capability to accept new discharges, particularly high nutrient sources such as landfill leachate and residential septage (TOGS 1.3.8 - *New Discharges to Publically Owned Treatment Works* - and 750-2.8(a)(1)).

  - Proper management/disposal of residual and process solids (7502.8(e)).

  - Bypasses are prohibited (750-2.8(b)(2)).

  - Eliminating direct discharges with emphasis on areas already identified in the DEC's 2002 Susquehanna and Chemung River Basins Watershed Restoration and Protection Action Strategy.

Permit Limits

- When nutrient removal treatment is constructed, then SPDES permits will include effluent limitations, including annualized nutrient loadings based upon what is consistently achievable with the constructed treatment at design/permit flow.

Level Two: For Significant Bay discharges only: Develop and initiate a process to establish action level permit limits (through 2008), optimize nutrient removal from existing treatment and enhance nutrient removal by minor treatment modification. Tine Frame – ongoing

Action Level

- After documenting current nutrient removal, performance-based nutrient action levels will be established for significant WWTP that do not already have TN or TP effluent limits. Complete nutrient monitoring at significant WWTPs began in 2005. A minimum of two years of such effluent data is needed to statistically establish the 95th percentile of performance that shall be used to establish action levels as 12-month rolling averages.

- For WWTPs with action levels at or below 12 mg/l TN or 2.0 mg/l TP (and equivalent loads), exceeding an action level will trigger corrective actions to return performance below the action level.

- For WWTPs with action levels above 12 mg/l TN or 2.0 mg/l TP (and equivalent loads), an individual schedule will be established to require such permittees to investigate and implement actions to optimize nutrient removal, including minor treatment modifications, and seek other potential nutrient source reductions. In addition, as a supplement to existing preliminary engineering assessments or conducting initial assessments, such permittees will be asked to identify cost-effective strategies to achieve greater levels of treatment, considering a range of effluent nutrient concentrations down to the levels of the best technology available.

Nutrient Removal Treatment Optimization/Minor Modification

- WWTPs that currently nitrify may find opportunities to cost effectively accomplish denitrification. Doing so may benefit a WWTP by stabilizing nitrification and saving aeration costs. Sixteen of 28 significant WWTPs, not including BJC, with a total of about 59 mgd presently nitrify at least part of the year.

- WWTPs may find opportunities where operational and/or minor chemical additions could cost effectively reduce nutrients.

- WWTPs may use findings from existing engineering assessments or conduct their own assessments.

- DEC staff shall provide technical assistance as appropriate.

Level Three: Develop and initiate a process to pursue widespread opportunistic nutrient removal upgrades. Time frame - Ongoing

This strategy level proposes prioritized WWTP improvements should additional funding become available, based upon multiple objectives including, local water quality impairment, existing infrastructure deficiencies, upgrade cost efficiency and overall potential to reduce nutrients delivered to the Bay, considering both load reduction magnitude and attenuation factors. Particularly for nitrogen attenuation, the size of receiving water and proximity to the Bay have a significant effect. Accordingly, the larger WWTPs located lower in the basin are generally the highest priority.

Local Water Quality Impairment
A priority is placed on solutions where investment in significant Bay WWTPs is necessary to achieve local water quality improvements and to meet statewide sanitary and combined sewer overflow abatement priorities.

Existing Infrastructure Deficiencies
The Division of Water Integrated Compliance Strategy System should be used to identify existing deficiencies.

Cost efficiency
Stearns and Wheler, Inc. and Delaware Engineering, Inc. completed preliminary nutrient removal assessments in November 2005 for 11 of the 28 significant WWTPs. These 11 represent the largest and others with opportunities for comprehensive plant upgrades. Analysis of preliminary engineering assessments reveals a cost-effective breakpoint at about $9/pound for total phosphorus and $6/pound for total nitrogen, based on a treatment level of 0.5 and 5.0 mg/l, respectively, for plants exceeding 1 mgd. As such, a priority is placed on identifying and implementing nutrient removal projects that are at or below these preliminary breakpoints. Additional knowledge about cost efficiencies will stem from follow-up nutrient removal optimization studies and implementation actions proposed in Level Two.

Size of Discharge
A priority is placed on WWTP upgrades that accomplish a larger magnitude of reduction.

Location of Discharge
Particularly for nitrogen, a priority is placed on upgrades that deliver a higher percentage of their discharge load to the Bay. In other words, a higher priority is placed on upgrades that have less travel time to the Bay and that discharge to larger receiving waters where there is less nitrogen attenuation.

Level Four: Widespread Nutrient Removal Upgrades
Time frame: Ongoing

To achieve the nitrogen Tributary Strategy goal for significant WWTPs at design flows and with BJC at 4mg/l, could mean only the next seven largest treating to 5 mg/l, or all treating to 8 mg/l. Upgrading fewer facilities to a higher level of treatment is generally a cost-effective approach. To achieve the phosphorus Tributary Strategy goal for significant WWTPs at design flows and with BJC at 0.9 mg/l, all significant WWTPs need to accomplish additional phosphorus removal treatment. This could mean that the 6 largest treat to 0.5 mg/l and the remaining to 1.0 mg/l.

To distribute waste load allocations, DEC will further consider unused capacity, future growth potential, impact on sewer rates, Bay watershed growth equity, trading/offset provisions and watershed or "bubble" type permits.

Table 7. Significant Bay WWTPs: NITROGEN

			Flow					TN Concentration annual average (mg/l)			TN Load annual average (lbs/year)				
SPDES#	Facility Name	Design (mgd)	2002	2003	2004	2005	2006	2004 (est.)	2005 (1)	2006 (1)	2004 (est)	2005 (1)	2006 (1)	TS Goal (2)	nitrification in permit
0024414	BINGHAMTON-JOHNSON CITY	22	19.854	23.812	22.045	19.980	20.49	18.8	18.1	17.5	1,274,894	1,100,862	1,090,914	(3)	
0035742	CHEMUNG CO. SD #2 - Elmira	12	6.710	7.830	8.140	7.963	8.48	15.0	14.1	16.7	373,188	341,786	430,319		Y = Year-round
0027669	ENDICOTT (V)	10	8.160	7.670	8.390	8.350	7.89	18.0	16.6	15.6	462,276	421,943	373,479		S = summer
0036986	CHEMUNG COUNTY SD #1	9.5	6.360	9.100	9.630	8.233	9.01	19.7	11.1	9.2	579,957	278,189	251,234		Y
0027561	CORTLAND (C)	9	7.380	7.510	7.580	6.575	8.42	17.4	14.7	11.1	402,708	294,220	283,482		Y
0023647	HORNELL (C)	4	2.790	3.930	3.580	2.383	2.46	15.7	14.1	15.8	172,180	102,283	118,093		Y
0031151	ONEONTA (C)	4	2.180	3.240	2.300	2.291	2.48	18.0	18.8	19.8	126,763	131,112	149,779		S
0025721	CORNING (C)	3.08	1.267	1.453	1.533	1.582	1.59	19.8	19.4	20.3	92,663	93,426	98,012		S
0021423	NORWICH	2.375	1.770	2.150	2.010	2.084	2.1	18.0	17.9	18.3	110,573	113,556	116,857		N = no
0025798	OWEGO #2	2	1.070	1.450	1.533	1.067	1.18	15.9	13.7	12.3	64,413	44,498	44,290		N
0023906	ERWIN (T)	1.75	0.586	0.640	0.708	0.635	0.6	18.0	5.1	5.5	38,938	9,858	10,046		S
0029271	SIDNEY (V)	1.7	0.550	0.570	0.530	0.571	0.6	15.5	20.0	20.4	25,144	34,764	37,187		N
0021431	BATH (V)	1	0.620	0.640	0.660	0.729	0.71	14.3	17.7	19.7	28,703	39,279	42,578		S
0029262	OWEGO (V)	1	0.880	0.780	0.570	0.465	0.47	15.4	22.2	23.9	26,874	31,424	34,194		N
0022357	ALFRED (V)	0.98	0.530	0.557	0.446	0.453	0.43	18.0	20.2	21.8	24,505	27,855	28,483		Y
0004308	KRAFT FOODS GLOBAL, Inc.	0.9	no data	0.850	0.834	0.911	0.91	6.9	3.8	4.2	17,673	10,538	11,579		N
0020672	HAMILTON (V)	0.85	0.512	0.587	0.547	0.538	0.61	29.3	14.9	13.4	48,930	24,402	24,827		Y
0031089	WAVERLY (V)	0.85	0.857	0.743	0.723	0.771	0.82	27.7	18.4	14	61,152	43,185	34,821		Y
0022730	OWEGO (T) #1	0.848	0.681	0.698	0.790	0.783	0.76	32.5	35.0	39.1	78,505	83,424	90,528		Y
0213781	CHENANGO NORTHGATE	0.8	0.563	0.583	0.531	0.672	0.64	19.1	18.3	17.9	31,038	37,435	34,834		N
0023591	COOPERSTOWN	0.75	0.511	0.637	0.519	0.531	0.58	19.0	10.7	14.6	32,783	17,296	25,777		S
0023248	CANISTEO (V)	0.7	0.242	0.396	0.416	0.332	0.31	18.0	7.1	4.2	22,837	7,176	3,972		N
0004189	AGRO FARMA, Inc.	0.67	0.604	0.552	0.591	0.582	0.48	closed	18.0	4		31,908	5,874		N
0031411	RICHFIELD SPRINGS (V)	0.6	0.410	0.430	0.440	0.425	0.47	16.6	13.6	10.3	22,439	17,595	14,722		Y
0025712	PAINTED POST (V)	0.5	0.248	0.276	0.246	0.242	0.31	18.0	14.8	15.9	13,505	10,903	14,976		S
0021407	GREENE (V)	0.45	0.191	0.259	0.200	0.203	0.44	18.0	18.8	18.4	11,029	11,618	24,591		N
0021466	SHERBURNE (V)	0.427	0.264	0.248	0.234	0.236	0.27	18.0	16.6	14.7	12,866	11,926	12,066		N
0020320	ADDISON (V)	0.42	0.174	0.209	0.243	0.217	.023	17.7	13.8	14.4	13,171	9,116	10,068		N
	Total										**4,169,707**	**3,381,577**	**3,417,582**	**2,100,000**	

(1) The 2005 and 2006 TN concentration annualized average is based upon discharge data collected since April/May 05 SPDES permit monitoring modifications made to all significant Bay discharges.

(2) The Tributary Strategy goal is based upon design flow.

(3) The BJC upgrade underway with de-nitrification filters is anticipated to achieve ≤6 mg/l TN. The final concentration limit for TN will be based on the outcome of the treatment study as described in the permit. Since this is a combined sewer system, the associated loading limit also will be based on an evaluation of anticipated annual flow. The anticipated result is about a 2/3 reduction from the current annual loading.

Table 8. Significant Bay WWTPs: PHOSPHORUS

SPDES#	Facility Name	design (mgd)	Flow 2002	2003	2004	2005	2006	TP Concentration annual average (mg/l) 2004 (est)	2005 (1)	2006 (1)	TP Load annual average (lbs/year) 2004 (est)	2005 (1)	2006 (1)	TS Goal (2)	P limit
0024414	BINGHAMTON-JOHNSON CITY	22	19.854	23.812	22.045	21.904	20.49	1.9	2.4	2.2	130,145	160,025	137,222	(3)	
0035742	CHEMUNG CO. SD #2 - Elmira	12	6.710	7.830	8.140	7.963	8.48	3.0	2.5	2.3	74,638	60,600	58,856		
0027669	ENDICOTT (V)	10	8.160	7.670	8.390	8.350	7.89	3.0	2.2	2.0	77,046	55,920	48,036		
0036986	CHEMUNG COUNTY SD #1	9.5	6.360	9.100	9.630	8.233	9.01	3.0	1.8	1.5	88,408	45,112	42,238		
0027561	CORTLAND (C)	9	7.380	7.510	7.580	6.575	8.42	2.2	1.9	1.4	51,438	38,028	35,115		
0023647	HORNELL (C)	4	2.790	3.930	3.580	2.383	2.46	3.0	2.6	2.5	32,817	18,861	18,721		
0031151	ONEONTA (C)	4	2.180	3.240	2.300	2.291	2.48	3.0	2.6	2.2	21,082	18,132	16,684		
0025721	CORNING (C)	3.08	1.267	1.453	1.533	1.582	1.59	3.0	3.3	3.5	14,061	15,892	16,747		
0021423	NORWICH	2.375	1.770	2.150	2.010	2.084	2.1	3.0	2.5	2.1	18,429	15,860	13,361		
0025798	OWEGO #2	2	1.070	1.450	1.533	1.067	1.18	2.3	3.0	2.5	9,323	9,744	8,980		
0023906	ERWIN (T)	1.75	0.586	0.640	0.708	0.635	0.6	3.0	2.3	2.3	6,490	4,446	4,183		
0029271	SIDNEY (V)	1.7	0.550	0.570	0.530	0.571	0.6	3.0	3.6	3.2	4,881	6,257	5,772		
0021431	BATH (V)	1	0.620	0.640	0.660	0.729	0.71	3.0	3.1	2.6	6,032	6,879	5,641		
0029262	OWEGO (V)	1	0.880	0.780	0.570	0.465	0.47	3.0	3.5	3.4	5,228	4,954	4,850		
0022357	ALFRED (V)	0.98	0.530	0.557	0.446	0.453	0.43	3.0	3.0	2.7	4,084	4,137	3,573		
0004308	KRAFT FOODS GLOBAL, INC.	0.9	no data	0.850	0.834	0.911	0.91	6.7	2.8	2.7	17,099	7,765	7,341		3.5
0020672	HAMILTON (V)	0.85	0.512	0.587	0.547	0.538	0.61	0.7	3.3	2.6	1,182	5,404	4,791		
0031089	WAVERLY (V)	0.85	0.857	0.743	0.723	0.771	0.82	3.8	7.7	9.9	8,322	18,072	24,662		
0022730	OWEGO (T) #1	0.848	0.681	0.698	0.790	0.783	0.76	1.8	2.5	1.4	4,331	5,959	3,239		
0213781	CHENANGO NORTHGATE	0.8	0.563	0.583	0.531	0.672	0.64	1.6	1.5	1.0	2,585	3,068	1,929		
0023591	COOPERSTOWN	0.75	0.511	0.637	0.519	0.531	0.58	3.0	2.7	2.5	5,190	4,364	4,432		
0023248	CANISTEO (V)	0.7	0.242	0.396	0.416	0.332	0.31	3.0	2.1	1.7	3,806	2,122	1,604		
0004189	AGRO FARMA, INC.	0.67	0.604	0.552	0.591	0.582	0.48	3	3	0.5	5,397	5,318	716		
0031411	RICHFIELD SPRINGS (V)	0.6	0.410	0.430	0.440	0.425	0.47	0.2	0.2	0.2	223	259	258		0.5
0025712	PAINTED POST (V)	0.5	0.248	0.276	0.246	0.242	0.31	3.0	4.1	2.8	2,251	3,020	2,623		
0021407	GREENE (V)	0.45	0.191	0.259	0.200	0.203	0.44	3.0	2.9	2.2	1,838	1,792	3,000		
0021466	SHERBURNE (V)	0.427	0.264	0.248	0.234	0.236	0.27	3.0	3.5	3.1	2,144	2,514	2,531		
0020320	ADDISON (V)	0.42	0.174	0.209	0.243	0.217	.023	3.0	3.3	2.8	2,229	2,180	1,967		
	Total										**600,699**	**526,684**	**479,072**	**210,000**	

(1) The 2005 and 2006 TP concentration annualized average is based upon discharge data collected since April/May 05 SPDES permit monitoring modifications made to all significant Bay discharges.

(2) The Tributary Strategy goal is based upon design flow.

(3) The BJC upgrade underway with de-nitrification filters is anticipated to achieve a significant reduction in TP. Upon completion of the treatment study described in the permit, TP concentration and loading will be incorporated into the SPDES permit. The anticipated result is about a 2/3 reduction from the current annual loading.

Urban Stormwater

Background

The New York portion of the Chesapeake Bay watershed is primarily rural, with low-intensity and high-intensity urban lands comprising only 5 percent of the area. The land cover estimates in Bay Watershed Model Version 4.3 are 68,314 acres of impervious cover and 141,681 acres of pervious urban lands. According to DEC, about 1,000 acres of land in 2005 were covered under its construction stormwater permit. Approximately 5 percent of New York's nutrient load (1,630,000 lbs/yr TN and 94,000 lbs/yr TP) is attributed to urban sources.

Although it is not a major overall contributor, developed area can produce concentrated nutrient loads, and reductions such as from structural retrofit projects, should be considered. It is also generally understood that high costs and uncertain performance of these projects often makes them less desirable to initiate. Through the DEC's stormwater discharge permit for construction activities, some retrofit projects will be implemented when developed areas are redeveloped.

This strategy emphasizes load reductions in developed areas primarily through maintenance of stormwater and drainage practices, municipal separate storm sewer system (MS4) programs and urban nutrient management. To limit pollutant loads from new development, emphasis is placed on erosion and sediment control during construction and on post-construction stormwater management facilities.

The framework for improved water quality from urban lands is provided by New York's stormwater management regulations. These regulations require State Pollutant Discharge Elimination System (SPDES) permits for stormwater runoff from certain construction projects, other industrial activities and MS4s. These permit programs are supplemented by training for municipal officials, design engineers, developers and contractors that promote improved management practices for all existing and new development.

Stormwater Construction Permit

The SPDES General Permit for Stormwater Runoff from Construction Activities (GP-02-01) is required for construction disturbing one acre or more of soil and includes redevelopment projects. The permit requires applicants to prepare and implement written stormwater pollution prevention plans. All such regulated construction projects must include erosion and sediment controls. Many projects also require water quality and quantity controls (stormwater management) to treat post-construction runoff and include ongoing operation and maintenance requirements.

The New York State stormwater management performance standard for water quality is to remove at least 80 percent of total suspended solids and 40 percent of total phosphorus. For water quantity, stream channel protection, overbank flood control and extreme flood control criteria are applied. New York State provides a compendium of practices that achieve these standards. Although nitrogen removal is not specifically addressed, it is reasonable to expect 30-50 percent removal. Technical standards for construction and post-construction stormwater management are found in the *New York Standards and Specifications for Erosion and Sediment Control* (August 2005) and the *New York State Stormwater Management Design Manual* (August 2003).

Stormwater Industrial Permit
The SPDES General Permit for Stormwater Discharges Associated with Industrial Activity (GP-98-03) requires certain industrial operators to develop and implement comprehensive stormwater pollution prevention plans.

MS4 Stormwater Permit
Additional stormwater management requirements are in effect within the "urbanized areas" of Elmira (22,177 acres in 11 Chemung County municipalities) and Binghamton (47,758 acres in 12 Broome County municipalities and one Tioga County municipality). Within these areas, MS4s are covered by the SPDES General Permit GP-02-02. This permit requires affected municipalities and counties to develop and fully implement stormwater management programs (SWMP) by January 8, 2008.

The SWMP must be designed to reduce the discharge of pollutants to the *maximum extent practicable* by implementing six Minimum Control Measures:

- Public education and outreach on stormwater effects
- Public involvement/participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management
- Pollution prevention/good housekeeping for municipal operations

DEC provides MS4 operators with guidance and other assistance to help develop and implement meaningful stormwater management programs (SWMP). SWMPs must target pollutants of concern, which in the Susquehanna Basin include nitrogen, phosphorous and sediment. SWMPs will achieve nutrient and sediment reductions through the following activities:

- Public education and outreach will reduce fertilizer use. This effort will be helped by the CBP's *Healthy Lawns Clean Water Initiative* wherein fertilizer manufacturers have agreed to achieve a 50% reduction in phosphorus applied in lawn care products by 2009 and to develop a similar approach for nitrogen.

- Public involvement programs are expected to include urban tree planting, establishment/protection of riparian vegetation and other stewardship activities.

- Public education programs will improve construction, operation and maintenance of septic systems. Inappropriate sewage discharges will be identified and eliminated as part of the "illicit discharge detection and elimination" requirement.

- Municipal oversight of construction site runoff will improve erosion and sediment control practices.

- Municipal oversight will improve long-term operation and maintenance of post-construction stormwater management practices.

- Municipal "good housekeeping" programs will include staff training and integration of pollution prevention into daily operations. Sediment and nutrient reductions will be achieved through the following activities: street sweeping, dry well and catch basin maintenance, roadway drainage improvements, road ditch BMPs, stream stabilization and nutrient management.

Local Government Involvement
In New York State, land use and development control rests with local governments. Even outside regulated MS4 areas, local governments can develop programs to manage construction site and post-construction stormwater runoff by adopting and enforcing local development standards. They can also implement non-regulatory measures, such as providing technical assistance, sponsoring training, reviewing construction site stormwater pollution prevention plans, and inspecting erosion and stormwater practices. Municipalities can also play a critical role by establishing mechanisms to ensure adequate long-term maintenance of drainage facilities.

Smart Growth Approach
Careful planning must accompany efforts to reduce nutrient and sediment loads from urban areas. Although the population in the New York portion of the Bay watershed has remained relatively stable and is not expected to significantly change, the amount of "developed" land will increase to some extent. Because it is generally quite expensive to construct retrofit practices, a cost-effective approach is to integrate drainage and water quality protection into local planning and development decisions. This can be accomplished through land use planning, local land use regulations, education and low impact development techniques.

The New York State supports enhancing local government capacity to find and implement smart, innovative solutions to strengthen the economy, improve environmental quality and enhance community livability. The following principles are supported:

- Revitalize downtowns and community centers
- Promote agriculture and farmland protection
- Conserve open space and other critical environmental resources
- Enhance transportation choices and encourage more livable neighborhoods
- Encourage sustainable development
- Strengthen Intergovernmental Partnerships
- Help create, implement and sustain the vision of a quality community

Smart Growth is a bottom-up approach. By focusing resources of numerous state agencies municipalities are assisted in implementing effective land development, preservation and rehabilitation strategies that promote both economic development and environmental protection. Municipalities receive training, tools and streamlined grant opportunities.

Outreach, Education and Training

To promote stormwater management practice improvements, DEC and other partners provide stormwater training to target audiences throughout the state. This outreach is supported by guidance documents and technical standards. On online stormwater information is located at http://www.dec.ny.gov/chemical/8468.html.

Documenting Implementation Efforts

The recently revised Notice of Intent form for SPDES General Permit GP-02-01 and the MS4 Annual Report provide information that enables documentation of new stormwater management practices. This documentation may underestimate erosion and sediment control and stormwater management practices, because not all activities require permit coverage. For example, erosion and sediment control practices during roadway drainage system maintenance (ditch cleaning, roadbank stabilization, etc.) can produce significant reductions in sediment and nutrient loads. This work is conducted by hundreds of highway departments throughout the basin. Outside of MS4 areas, no reliable method for documenting the erosion and sediment control benefits currently exists. Although it is difficult to document, DEC and the USC will continue to promote management practices for roadside drainage and maintenance.

Anticipated Implementation

The following management practices have been reported under the Stormwater Construction Permit. The anticipated implementation levels are based on previously collected permit data and may be adjusted as additional information becomes available. The acreage is based on the conservative assumption that the area protected by each management practice is limited to the area of disturbance for the project.

Table 9. Urban Stormwater Implementation

Wet ponds and wetlands	**2,500 acres** in Urban category (additional protection)
Dry detention and dry extended detention ponds	**0 acres**
Filtering practices	**100 acres** in Urban category (additional protection)
Infiltration practices	**1,000 acres** in Urban category
Erosion and sediment control	**5,000 acres treated** in Urban category (Erosion and sediment control is required on all construction sites disturbing > 1 acre.)

Septic Systems

Septic systems or on-site wastewater treatment systems (OWTS) make up a significant portion of the total residential wastewater treatment infrastructure in the New York portion of the Chesapeake Bay watershed. The Chesapeake Bay Program estimates that about half of the residential population in this area of New York, or about 300,000 people, is served by about 120,000 OWTS. Where not operating properly, OWTS can result in local groundwater and surface water quality problems. The DEC's "Waterbody Inventory/Priority Waterbodies List" includes 15 lakes and 5 stream segments in the Susquehanna and Chemung River basins affected by OWTS.

Based on an assumption that all phosphorus from properly operating systems is retained in soil, the Bay Watershed Model does not assign any phosphorus to this source category. In New York, experience suggests that phosphorus from OWTS does impact surface water. Because studies show that most of the nitrogen from OWTS is removed by natural processes in soil, the Bay Watershed Model attributes only about 10 pounds of nitrogen per year to streams for each system.

Residential OWTS are regulated by the New York State Department of Health (DOH), or are delegated to county health departments. DOH construction standards for new and replacement systems were updated in 1996. Larger OWTS, including private, commercial and institutional systems, are regulated by the DEC. Construction standards for these systems are found in the DEC's *1988 Design Standards*.

The DEC and DOH have worked together to identify and prioritize resolution of rural areas with clusters of sub-standard systems and/or direct discharges. The *Susquehanna and Chemung Watershed and Restoration and Protection Action Strategy* (WRAPS, 2002) was based on such a process and identified six municipalities that applied for or received funding to correct the OWTS problems. Some of these sites have since been corrected. The WRAPS also recommended that 12 areas should begin studies and obtain funding to develop centralized wastewater treatment facilities and/or OWTS management districts. Remaining sites are a priority of this strategy. The State Revolving Fund, Environmental Protection Fund and County Water Quality Committee Mini-Grants are available to communities to help resolve OWTS problems.

In addition, the DEC has identified sub-standard OWTS as a significant contributor to pollutants in urban stormwater runoff. By January 2008, municipal separate storm sewer system operators are required to implement a process to identify and eliminate such illicit connections. This requirement is expected to reduce the number of sub-standard systems in urban areas.

While New York State does not routinely inspect residential OWTS, several watershed based programs have developed. In some areas, such as Lamoka - Waneta Lakes and Otsego Lake local inspection and enforcement programs exist. The Otsego Lake watershed is also the site of a demonstration project intended to increase the knowledge and understanding of advanced OWTS, including increased phosphorus removal capability.

As a means to protect water resources in a cost-effective manner, municipal management of OWTS is encouraged. The Department encourages municipalities to conduct OWTS inspections and to develop OWTS management strategies. Nine such projects were awarded state grants in 2005. A local initiative in Schuyler County has used funding from various sources to cost-share replacement of failing or antiquated septic system components.

To further assist municipalities, the DEC is involved in the development of a statewide training program for OWTS professionals. A largely volunteer industry group called the Onsite Wastewater Treatment Training Network (OTN) has been formed. The Department has provided financial and staff support to the OTN during the last five years.

A GIS-based inventory and tracking software now includes a module that local officials, watershed professionals and consultants can use to inventory and map septic systems. In addition to attributes such as tank size and material, the module allows linking photographs, plans and inspection records to each system. An inspection form has been developed by the OTN and is available for use in this system.

Because OWTSs make up a minor fraction of the total nitrogen load and because de-nitrifying systems are expensive (more than $200 per pound of nitrogen removed), major nitrogen reductions from OWTSs are not considered practical. Although there could be isolated instances where additional nitrogen removal systems may be needed to meet local groundwater quality standards, de-nitrifying systems are not included in this strategy.

The CBP watershed model does credit septic tank pumping for a 5 percent nitrogen reduction. Because this management practice has universal application as a beneficial maintenance practice, it is applied to all OWTS in this strategy.

Chapter Three WATERSHED PATHWAYS

Wetlands

Wetlands are a priority component of this strategy and the USC. Protection, enhancement, rehabilitation, establishment and reestablishment are promoted for multiple objectives, including flood attenuation, nutrient and sediment reduction and habitat improvement.

Background

In the New York portion of the Chesapeake Bay watershed, wetlands total about 165,510 acres, or 4 percent of the landscape. Participating landowners, in cooperation with USDA NRCS, US FWS, USC and Ducks Unlimited, have established or reestablished 3,997 wetland acres in recent years. To add wetland acres, experience suggests that additional landowner participation can be found readily. Pursuing this voluntary approach is an important component of this strategy. It is also important to conduct watershed analyses to maximize the quality, usefulness and cost effectiveness of wetland projects.

Wetlands for Flood Attenuation

Flooding, streambank erosion, gravel deposition and stream siltation commonly stress streams and affect farmland, residences, bridges, roads and other infrastructure in the upper Susquehanna basin. Particularly in first and second order stream watersheds, wetlands can substantially help alleviate these problems because their holding capacity and vegetation act to temporarily detain runoff, reduce velocities and desynchronize peak flows. Slowing the runoff also helps to reduce downstream erosion.

Because of steeper topography, wetlands in such headwater areas tend to be smaller and slightly more costly to build. Yet, they commonly have less construction and permit requirements because of their remote location and size. Watershed analysis will be important to determine where headwater wetlands would be most beneficial. It is also important to create wetland designs that allow temporary water storage without adversely affecting associated plants and animals.

Wetlands for Nutrient and Sediment Reduction

Wetlands reduce nitrogen and phosphorus by filtration, chemical precipitation and adsorption, microbial interaction and uptake by vegetation. In particular, wetlands in headwater areas, which are predominantly forested in New York, may be important sinks for nitrogen from atmospheric deposition.

In general, nutrient reduction efficiencies in wetlands vary widely due to many variables in naturally functioning systems. Important wetland design parameters include retention time, watershed size, wetland location and rainfall magnitude and intensity. Maintaining wetland hydrology is especially important to allow denitrification process to occur. To maximize nutrient reduction efficiencies, wetlands should be located to retain runoff with higher nutrient concentrations, such as from cropland. Such wetlands with riparian buffers are an important management practice combination for implementation and study.

Wetlands for Habitat Improvement
Developing wetlands on degraded or former wetland sites are a general priority of this strategy. Accordingly, many wetland projects are likely to also improve habitat. In addition, this strategy supports vernal pool or ephemeral wetlands development. Although this type of wetland may have less nutrient reduction potential, they support their own specialized fauna and flora due to the temporary nature of their existence. This makes them important contributors to species diversity. The wetland work described in this strategy also complements and supports the recent federally approved New York State Susquehanna Comprehensive Wildlife Conservation Strategy.

Wetland Protection
The New York State Freshwater Wetlands Act (FWA) and Environmental Conservation Law Article 24 provide the DEC with the authority to regulate freshwater wetlands. The main provisions of the FWA are to regulate those uses that would have an adverse impact on wetlands, such as filling or draining. The FWA contains the following Declaration of Policy:

"It is declared to be the public policy of the state to preserve, protect and conserve freshwater wetlands and the benefits derived therefrom, to prevent the despoliation and destruction of freshwater wetlands, and to regulate use and development of such wetlands to secure the natural benefits of freshwater wetland, consistent with the general welfare and beneficial economic, social and agricultural development of the state (ECL Article 24-0103)."

The FWA protects those wetlands larger than 12.4 acres (5 hectares) in size, and certain smaller wetlands of unusual local importance. Around every regulated wetland is a regulated adjacent area of 100 feet, which serves as a buffer area for the wetland. In the New York portion of the Bay watershed, the FWA protects 55,886 acres of wetlands or about 34 percent of the existing wetlands. The U.S. Army Corps of Engineers also regulates these and smaller wetlands under the Federal Clean Water Act. In total, about 78,752 acres or 48 percent of wetlands in the watershed are protected, including FWA wetlands, smaller wetlands on state land, wetlands with conservation easements, such as USDA, NRCS, WRP projects and wetlands held by conservation organizations, such as the Finger Lakes Land Trust.

USC Wetland Program
The overall goal of this strategy and the USC Wetland Program is to develop a wide array of wetlands that meet the specific criteria of the funding programs, while attempting to integrate these designs into a plan that maximizes local benefits.

Every funding agency has different criteria and a different philosophy behind its wetland program. The USC's goal is to design wetlands that fit the site characteristics, landowner's wishes, local watershed objectives and the funding agencies' requirements. With such a flexible approach, the USC is able to maximize the number of sites and total wetland acreage in a watershed while taking into account these sometimes conflicting needs. Following is a list of partner agencies and organizations and their roles (in alphabetical order):

- The **Chesapeake Bay Program** has potential funding sources for wetland construction.

- **Ducks Unlimited** can provide complete wetland restoration/construction services and they may provide in-kind support for grant applications.

- The **EPA** provides "5 Star" grants for wetland construction, "Watershed Assistance" grants for planning and "Wetland Development" grants for larger wetland projects. Additional opportunities such as the EPA Targeted Watershed Initiative, earmarked for the Bay watershed, may provide additional support.

- The **Izaak Walton League of America** has an ephemeral wetlands and Susquehanna River initiative. They have expressed interested in partnering with USC on outreach and related efforts.

- **Landowners** contribute land and support for wetlands.

- The **NYS Department of Environmental Conservation** has funding opportunities under the Aquatic Habitat Restoration Program, funded through the New York State Environmental Protection Fund.

- The **NYS Department of State** can provide funding for planning under its Waterfront Revitalization Program.

- The **NYS Department of Transportation** has potential for partnering on projects that are in proximity to their road systems.

- The **NYS Emergency Management Office and the Federal Emergency Management Agency** may be funding partners, especially if a strong case can be made for flood attenuation benefits of a project.

- The **Susquehanna River Basin Commission** has begun to investigate the potential for groundwater recharge and wetland development as part of its overall strategy.

- **Soil and Water Conservation Districts** in the USC are an integral component of the USC local delivery team.

- The **U.S. Army Corps of Engineers** has the potential to fund wetland projects under the Chemung/Susquehanna Water Resources Development Act.

- The **USDA Natural Resources Conservation Service** provides funding and technical help under its Wetland Reserve Program, which is a key component of the USC wetlands program.

- The **U.S. Fish and Wildlife Service** is an important team member at several levels; it can provide technical help and funding under its Partners for Wildlife program; it also provides funding through the North American Wetlands Conservation Act.

- **Villages**, **towns** and **counties** in the project watershed are important stakeholders. Their support is needed, in part, because several potential funding sources require municipal sponsorship.

At present, the USC Wetlands Program has funding through the USFWS Partners for Wildlife Program, EPA Targeted Watershed Initiative, EPA Wetland Development Grant, an EPA 5-Star and a NYS DEC Aquatic Habitat Restoration grant. The USDA NRCS WRP is also a major contributor. **The Tributary Strategy goal is the establishment, re-establishment, enhancement or rehabilitation of an additional 7,344 acres of wetlands, including 3,344 in agriculture and 4,000 on other land cover types.**

The Stream and Road Corridor

Background

Streams and roads are closely related in the upper Susquehanna region. It is generally hilly terrain with many roads and a long history of settlement along its valley streams. There are about 13,800 miles of streams and 17,000 miles of roadways. The proximity of so many roads and streams and the underlying geologic features create situations where stream bank erosion and related problems are common. Such instability is more pronounced because of large deposits of unconsolidated material left from the last glacial period and well-intended historical efforts to control streams. The combination of such landform and settlement patterns causes localized and frequent flooding and other water quality/habitat issues related to sediment transport.

Although sediment reduction is not a major component in this strategy to restore Chesapeake Bay water quality, sediment is a common concern in local streams, and many local resources are used for stream and road drainage maintenance. Accordingly, this strategy devotes attention to streams and roadways to help use such resources in a cost effective and meaningful manner. In so doing, attaining New York's nutrient tributary strategy goals for Chesapeake Bay improvement is helped because streamside actions which act to reduce sediment also help to reduce nutrients.

Guiding Principles

The following principles will help local implementation efforts. The USC counties have agreed to promote these principles within their counties and to integrate additional state, regional and federal principles as they arise from improved understanding of the complex interactions involved.

- Stream issues will be approached in a systemic manner considering whole watershed condition and impact.

- When possible, stream monitoring data as opposed to stream "perceptions" will be used to determine rate and status of impairments.

- Where possible, stream issues will be approached with a comprehensive restoration objective as opposed to a more limited site-specific stabilization approach.

- Restoration includes consideration of geomorphic, hydrologic, habitat, water quality, riparian, social and economic values.

- Stream and road corridor issues will be approached in a pragmatic manner, with the realization that funding, materials and other resources are limited. Educating landowners, municipal officials, maintenance personnel, land use planners and others is important to effect cultural change in how we manage our streams, roads and watersheds.

- Creative, cost effective approaches to stream restoration are encouraged.
- To lessen flood damages and promote stream stability, the hydraulic function of floodplains should be protected and/or restored.
- Lessons learned regarding stream restoration (what works and what doesn't work) will be shared and networked.
- To facilitate local empowerment through education, training and actual implementation experience, the use of local designers, contractors and material suppliers is encouraged.
- Further research of regional stream system characteristics is needed to better understand the complexity of local streams and how they function.
- Streamside property owners will be encouraged to replace lawns and other potentially unstable cover types with forested riparian buffers.

Assessment
The Upper Susquehanna Coalition partnered with the Environmental Resource Research Institute at Penn State to develop a suite of Arc View GIS-based environmental assessment tools for use by environmental professionals, which can be found at http://www.u-s-c.org/html/Projects.htm. The Arc View-based Stream and Environmental Assessment Monitoring System (AVStrEAMS) combines many components to provide an environmental assessment report for a particular stream segment and the surrounding area. This program also assesses the stability and erosion status of road ditches and road banks. AVStrEAMS utilizes some of the most widely recognized federal and state environmental assessment protocols, as well as some developed in-house for unique situations. The USC is also working with a Cornell University researcher to study the nutrient content of road ditch sediment and how the sediment may affect stream function.

Stream Stabilization
Today, many stream projects attempt to protect existing development from flooding and/or erosion threats by stabilizing stream banks in the immediate vicinity. Stabilization techniques include rock riprap, retaining walls, drop structures, stream vanes, willow planting and other techniques. Typically, funding is available only for stabilization of the immediate area, rather than restoration of the stream reach. While many projects initially meet site specific needs, too often the root cause of such instability is not addressed, leaving the site and adjacent stream segments subject to the same erosion problems. Although this strategy promotes increased attention to stream restoration of broader scope, it recognizes the importance of protecting critical infrastructure and that site-specific stabilization projects will continue by necessity. Accordingly, a strategy component is to identify stabilization practices that have longevity and do not exacerbate problems in adjacent areas.

Stream Restoration

Stream restoration involves restoring a stream and ecosystem to a close approximation of its condition prior to hydrologic changes caused by human activity, such as road and bridge building, logging and agriculture. It is larger in scope compared to site specific stabilization projects. The restoration objective is to have a stable stream channel that experiences no net aggradation or degradation over time. Over the long term, such stable stream channels require less remedial work, lessen flood damage, improve habitat and ultimately save money. Because current resources are limited, restoration projects need to be carefully planned. The USC is presently piloting several small natural stream design projects under an EPA Targeted Watershed Initiative Grant.

Not all measures need to be structural. For example, flood mitigation funding has been used to buy out and remove several repetitively flooded structures and restore natural floodplain functions in Chemung County. In this way, the stream corridor can flood without further "restoration expenses" incurred. In addition, by returning some hydraulic function of the floodplain, downstream flooding may be reduced.

Roadway Implementation

Stabilizing road ditches and banks is a local priority, not only to minimize stream pollution, but also to improve highway safety and reduce ditch maintenance. Changes in how water flows along and across roads also can reduce erosion and flooding problems. Stream road crossings frequently contribute to stream instability due to channel alterations and floodplain encroachments that may occur. Dredging and other maintenance activities intended to protect this infrastructure may also contribute to stream destabilization.

Several roadway practices are beneficial, including hydro-seeding, grade breaks (check dams), under-drains, French mattresses (allowing water under the road through course stone), crown reshaping, profile and cross slope modification, high-water bypass techniques and the use of different surface aggregates. In-stream design structures, such as cross vanes, also protect bridges and culverts. Wetlands and other buffers also can be specifically designed and constructed or restored to capture road ditch runoff to reduce energy, capture sediments and provide opportunity to denitrify atmospheric and automobile exhaust sources of nitrogen. Incorporating these concepts into planning, implementation and training efforts is essential.

Outreach, Education and Training

Property owners are primary partners to help maintain healthy and stable stream corridors. Providing the general public with accurate information about stream processes, and technical support to design and implement stream projects is important. A short review of this topic was developed by Chemung County SWCD entitled *Investigating Potential Water and Flood Control Problems Before You Buy or Build.* In a much more extensive outreach effort, the USC is developing a booklet and PowerPoint presentation entitled *Stream Processes: A Guide to Living in Harmony with Streams*.

Training opportunities for local highway personnel also are clearly essential. Training materials include those developed by Steuben County; *Highway Superintendent Road and Water Quality Handbook, Edition 2*, the Cornell Local Roads Program, the PA Dirt and Gravel Roads Program and NYSDOT *Environmental Procedures Manual*. The USC is conducting educational workshops for town, county and state highway staff using the PA Dirt and Gravel Road Program's new training curriculum, www.dirtandgravelroads.org.

Because the guiding principles agreed to by the USC counties support comprehensive stream restoration rather than site-specific stabilization where possible, the use of restoration techniques will increase. In an effort to improve the local capacity for implementation, the USC also has sponsored numerous training sessions in natural stream design principles. Most SWCDs now have some level of training and experience with stream and roadway restoration.

Regulations
New York State Environmental Conservation Law calls for preservation and protection of the state's lakes, rivers, streams and ponds under Title 5, Article 15. This law is implemented through the Protection of Waters Regulatory Program, which regulates three different categories of activities:

1. Disturbance of the bed or banks of a **protected stream**

2. Construction, reconstruction, repair and removal of **dams**

3. Excavation or filling or both in **navigable waters** of the state, including adjacent marshes and wetlands

This regulatory program is complemented by Soil and Water Conservation Districts, which provide technical assistance to applicants to minimize adverse impacts on streams.

In New York State, most municipalities also affect development in stream corridors through their participation in the National Flood Insurance Program. To participate in this program, municipalities regulate floodplain development. This includes ensuring that new development does not reduce the hydraulic capacity or increase the potential for erosion or other damage.

In addition, some municipalities include stream setback requirements and other stream corridor management provisions in local land use regulations. For example, some towns have stream setback requirements, such as: "No building shall be located within 50 feet of any streambank." In the towns of Hornby and Caton in Steuben County, additional requirements were added that any development within the stream setback zone (driveway, tree removal, etc.) would be subject to site plan review.

The Town of Elmira in Chemung County has a conservation district in its zoning law that corresponds to the floodway of the river. It includes areas that "should be preserved and utilized only for less intensive and carefully considered development that is compatible with the sensitive nature of such lands and to ensure that the existing character, nature and benefits derived from such lands are preserved and retained." The only permitted uses in this district are: agriculture, campground, outdoor commercial recreational use, public recreation/park and commercial stables.

The Town of Erwin, Stueben County, has a stream corridor overlay zone along some streams. The "overlay" means that it is not a separate zoning district but establishes requirements within the designated area that apply in addition to those of the underlying land use district (i.e., floodplain regulations are sometimes included in zoning ordinances as an overlay district.) The overlay district includes a requirement for a special use permit, which enables the town to evaluate potential impacts on a case-by-case basis, setback requirements and limits on vegetation removal.

Documenting Implementation Efforts

Several potential sources of information for stream and roadway implementation projects exist, including SWCDs which have installed natural stream design practices, MS4 operators in the Elmira and Binghamton urbanized areas, the New York State Department of Transportation (NYSDOT), and county and local highway departments. In particular, as part of its Environmental Initiative, NYSDOT routinely incorporates stormwater control measures into its projects and seeks to retrofit existing highway drainage systems.

It is possible to document practices for submittal to the CBP for obtaining sediment and nutrient reduction credit. This task may be large in relation to its return. Nonetheless, the implementation of stream and roadway practices is an extremely high local priority and, therefore, an important aspect of this strategy.

Groundwater

Groundwater is a valuable resource that supplies both drinking water and stream flow. DEC records indicate that more than 3 million residents in upstate New York get their drinking water from groundwater, with a majority from private wells. In addition, a study performed by the United States Geological Survey in the upper Susquehanna River basin in New York State concluded that during a 52-year period (1942-1993), baseflow had contributed more than 60 percent of total annual flow in the rivers and streams that were monitored. Accordingly, this Tributary Strategy recognizes the significant role groundwater plays as a source for both drinking water and stream flow. The primary purpose of this Tributary Strategy is to reduce nutrients in the Chesapeake Bay and protecting groundwater from excess nutrients is an important component of that effort.

Nutrients from septic systems, agriculture, urbanized areas and other land uses may enter groundwater. Many nutrients, especially nitrates, do not degrade in groundwater. To ensure groundwater is protected, a priority is placed on implementing practices that reduce the amount of nutrients applied to the landscape and/or that prevent excess nutrients from leaching into groundwater.

Examples of practices that are beneficial for both surface water and groundwater protection include cover crops, agriculture nutrient balancing, septic system maintenance, urban nutrient management and other nutrient source controls. To facilitate additional groundwater protection, communities are already provided incentives by the DEC and DOH to develop and implement wellhead and source water protection plans.

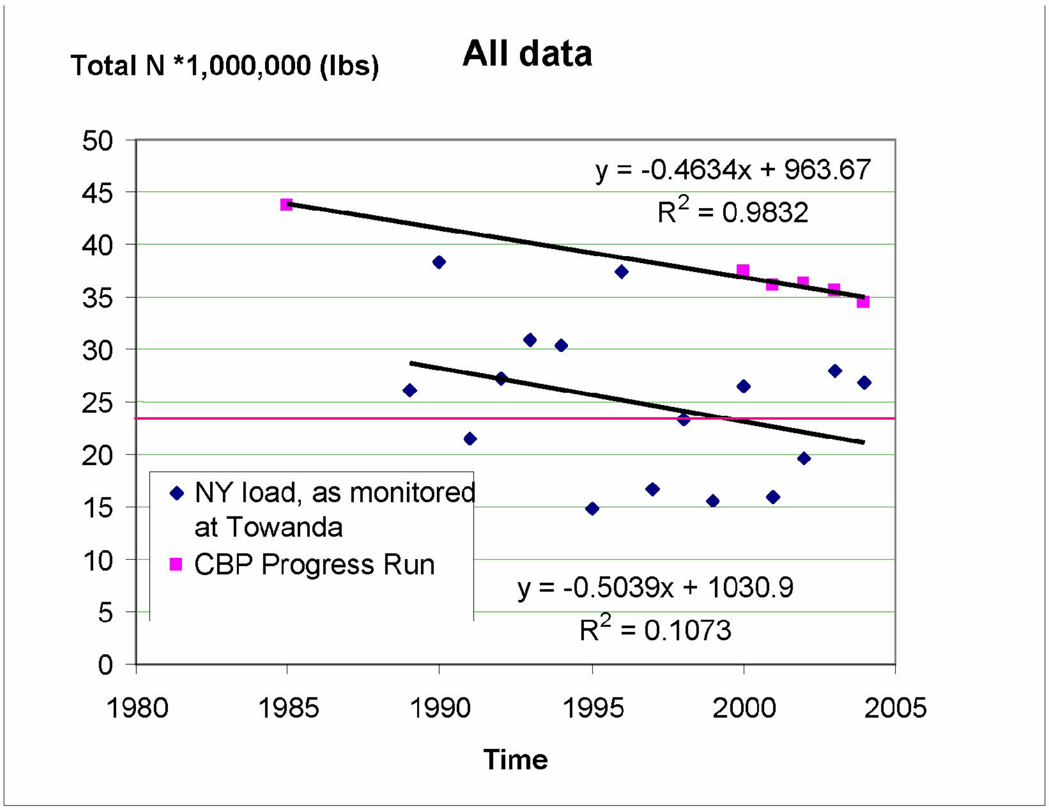
Because a large number of individual residences and certain municipalities like the cities of Corning and Cortland rely on groundwater for drinking water, it is especially important to be protective of groundwater quality. In general, glacial geology has left relatively shallow and productive sand and gravel aquifers in the valley bottoms of major watersheds, which is particularly well understood in Cortland County. These aquifers are replenished by direct infiltration of rainfall and snowmelt in the valley areas, by lateral groundwater flow from upland areas, and by upland runoff that can infiltrate to groundwater upon reaching the valley floor. This recharge path makes groundwater very susceptible to surface activities.

Chapter Four INFORMATION NEEDS FOR BAY WATERSHED MODEL

The current Bay Watershed Model (Version 4.3) is now being refined (Version 5.0), which should help to resolve many of the information needs described below.

Model Calibration

Model calibration will improve in Version 5.0 by using the United States Geological Survey (USGS) gauging station at Towanda, PA. According to the CBP, about 86 percent of the monitored load at Towanda is attributable to New York. As seen in the chart below, the current model may over estimate the amount of nitrogen from New York. The red line depicts the New York Cap Load Allocation equivalent as generated in New York.



Land Cover Types

As seen in the table below, the number of land cover types in Version 5.0 increases from 10 to 21 and the amount of land in each type changes. Digital land use information collected by the USC will continue to help make coverage estimates more accurate.

<table>
<tr><th>Table 10. NY Chesapeake Bay Watershed Model Version 5.0 Land Cover (All definitions are per the Chesapeake Bay Program)</th><th>Version 5.0 (acres in 2000)</th><th>Version 4.3 (acres in 2004)</th></tr>
<tr><td>1. Open Water: Areas of open water (fresh water lakes, ponds, rivers, streams, canals), generally with less than 25 percent cover of vegetation or soil</td><td>23,095</td><td>33,381</td></tr>
<tr><td>2. Construction: Urban construction calculated as the average yearly change</td><td>1,008</td><td>Part of Urban Categories (4-7)</td></tr>
<tr><td>3. Extractive: Includes both active and abandoned mines</td><td>619</td><td>New</td></tr>
<tr><td>4. Low Intensity Urban – Pervious</td><td>93,338</td><td rowspan="2">141,681</td></tr>
<tr><td>5. High Intensity Urban – Pervious</td><td>72,903</td></tr>
<tr><td>6. Low Intensity Urban – Impervious</td><td>7,039</td><td rowspan="2">68,314</td></tr>
<tr><td>7. High Intensity Urban – Impervious</td><td>21,057</td></tr>
<tr><td>8. Forest: Consists of deciduous, evergreen and mixed forests in which tree species account for more than 30 percent of total vegetative cover. Forest land also includes wetlands.</td><td>2,809,028</td><td rowspan="2">2,477,406</td></tr>
<tr><td>9. Harvested Forest: Consists of 1 percent of total adjusted forest land use to account for disturbed and harvested forests</td><td>28,374</td></tr>
<tr><td>10. Natural Grass: Areas with “natural” grass species accounting for more than 70 percent of vegetation cover</td><td>15,669</td><td>New</td></tr>
<tr><td>11. Mixed Open: Includes everything not otherwise categorized</td><td>Spread into other categories</td><td>527,233</td></tr>
<tr><td>12. Pasture: Contains only “pastureland” from Agricultural Census (060073). Pastures do not receive fertilizer but can have higher nutrient loading capacity than hay or idle land due to manure from grazing animals. The Agricultural Census does not report pastures used. In Version 5.0, horse pastures are included in the natural grassland category.</td><td>289,079</td><td rowspan="2">265,397</td></tr>
<tr><td>13. Disturbed Stream Corridor/Trampled Ground: Consists of 0.5 percent of the total pasture by land river segment to account for non-fenced streams in pasture and other animal trampled areas</td><td>1,453</td></tr>
<tr><td>14. Alfalfa: Contains only “alfalfa hay.” This is a dominant hay crop in many areas of the watershed. It is separated out because it is a nitrogen-fixing crop and receives less nutrient applications than hay crops.</td><td>112,812</td><td rowspan="2">218,851</td></tr>
<tr><td>15. Hay with Nutrients: Includes all tame and small grain hay but not wild hay or alfalfa, which are included in other categories. These crops receive fertilizer or manure and have a high degree of surface cover for most of the year. Failed cropland is also included in this category because it also receives fertilizer but is not harvested.</td><td>234,142</td></tr>
</table>

16. Hay without Nutrients: Includes hay or other herbaceous agricultural areas that do not receive fertilizer and are not harvested, such as wild hay, idle cropland, fallow land and unharvested land in cover crops. Orchards also are included in this category. Although orchards contains trees, the trees are widely spaced and do not have the same runoff characteristics as a forest. The grassy areas between orchard trees are not fertilized or harvested and respond to rainfall events similarly to wild hay or idle land.	96,680	
17. Composite with (or w/o?) Manure Conservation Tillage: Includes corn, soybeans, small grains, sorghum and dry edible beans	15,606	18,436
18. Composite with (or w/o?) Manure Conventional Tillage: Includes corn, soybeans, small grains, sorghum and dry edible beans	166,228	243,249
19. Composite Crop without Manure: Includes potatoes, vegetables and berries under either conservation or conventional till	9,861	Part of 17 and 18
20. Nursery: Includes all nursery crops grown in the open, including bedding and flowering plants, cut flowers and floral greens, foliage plants, cut Christmas trees, sod and mushrooms	10,243	New Category
21. Animal Feeding Lots and Concentrated Animal Feeding Lots: Includes areas of high animal concentration with bare ground and high manure content	966	966
Total Agriculture: Numbers 12 through 20	936,102	745,933
Total Area:	4,008,233	3,993,948

Input Data

Input data estimates based on interpolation may be inaccurate. Version 4.3 estimates for New York are based on two sub-watersheds: the Chemung Basin in the west and the Susquehanna Basin in the east. Version 5.0 will use 72 smaller sub-watersheds within the Chemung and Susquehanna, of which all or portions are in New York. The smaller sub-watersheds are further broken down along county lines so there are 156 "watershed polygons" for New York. The CBP develops estimates for model inputs based on the larger number of watershed polygons because most information is collected at the county level and then distributed to the corresponding watershed. Because, in many cases, only small parts of counties are in the New York portion of the Bay watershed, and because of wide variation in land use within counties, interpolating data from county wide totals generally can lead to inaccuracies.

Beef Cattle

The USC predicts that Version 4.3 overestimates the number of beef cattle in the New York portion of the Bay watershed. This is an important modifier to nutrient discharge predictions, and the number of beef cows should be verified.

Confined Animal Manure

Version 4.3 predicts that 20 percent of all cow manure from confined animals runs off without being modified by management practices. This amount may be high and results in a significant nutrient contribution that is not manageable.

Purchased Fertilizer

Version 4.3 uses a crude estimate for purchased fertilizer. CNMP reviews may provide better estimates.

Cow Weights

Because the model predicts nutrient output from cows based upon average cow weight, it is important to know the average weight of New York cows.

Alfalfa

The Version 5.0 estimate for pure alfalfa acreage is higher than the USC expects. This is important because alfalfa is a nitrogen-fixing plant and may be considered as an important nitrogen source.

Pre-Nutrient Management Plan

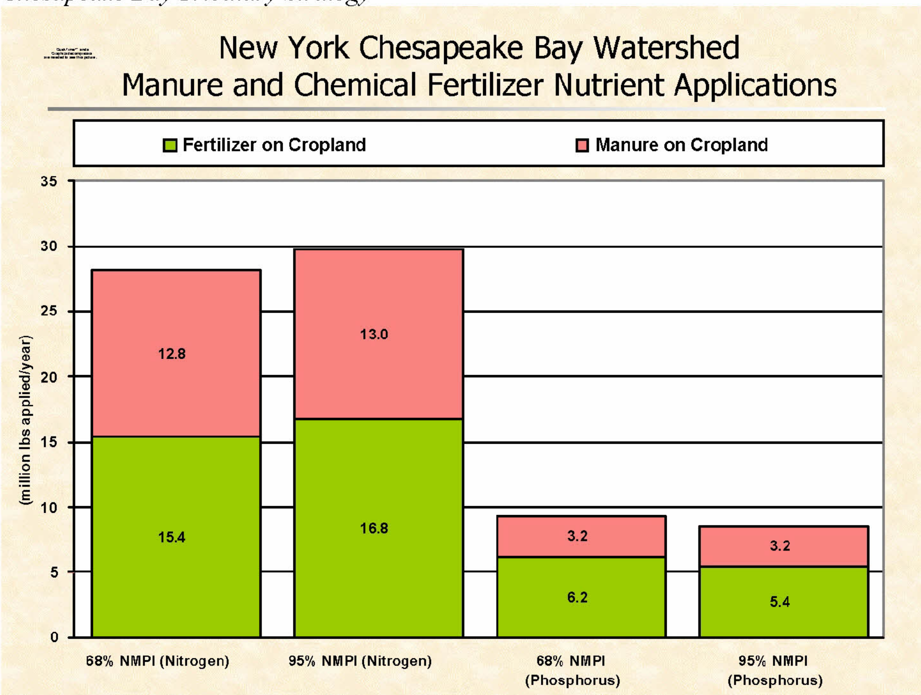
Version 4.3 may use too low of a "pre-nutrient management plan" nutrient level, such that CNMP implementation in New York receives too little nutrient reduction credit.

Manure Nutrients

It is not clear why Version 4.3 predicts that the nutrient content in manure increases over time.

Phosphorus-based CNMP

By asserting that all CNMPs are based on phosphorus, Version 4.3 predicts that nitrogen increases when CNMPs are implemented, as seen in the chart below. This is not necessarily the case in New York.



Delivery Factor

Due to the long distance to the Bay, nutrient and sediment from New York is also subject to extensive in-stream processes, particularly for nitrogen. Such delivery factors are not easily quantified in the model. Version 4.3 assumes, as streams get "cleaner," that a greater percentage of nutrients are transported to the Bay. This delivery factor concept is most important to headwater areas. For New York, the delivery factor increase from 45 to 55 percent for nitrogen and from 39 to 53 percent for phosphorus, as maximum implementation levels are reached compared to no implementation. If the delivery factor did not change, then nutrients delivered to the Bay would be reduced by 2,378,665 pounds of nitrogen and 154,749 pounds of phosphorus. Because of this significant difference, it is important to better understand delivery factors, such as through direct empirical data or the USGS Spatially Referenced Regressions on Watershed Attributes (SPARROW) model.

Atmospheric Deposition

Atmospheric deposition may be significantly underestimated. Research on fundamental processes underlying the model simulations, including several projects that are being supported at the North American Nitrogen Center (NANC) at Cornell University, will provide a better understanding of nitrogen delivered to rivers from major sources. These include volatilization of ammonia from agriculture and atmospheric deposition of nitrogen from fossil fuel combustion and electric utilities. The NANC, www.eeb.cornell.edu/biogeo/nanc, has identified improved understanding of the roles of atmospheric nitrogen deposition and subsequent forest retention in the Susquehanna Basin as a major focus for needed research.

Forests as a Nitrogen Source
Although water quality research studies in the upper Susquehanna basin of New York are limited, there is information from published literature to obtain estimates of nitrogen exported from forested watersheds. A study of low order streams draining directly to the Susquehanna River estimated total nitrogen concentrations to be 0.30 mg L^{-1} (1). Assuming that half of the rainfall in a watershed is exported yearly in stream water, then the total yearly nitrogen export from these forested watersheds average 1.34 pounds per acre versus 3.82 pounds assumed in Version 4.3.

Early Successional Forests
Better understanding of nitrogen use by early successional forests, including "old fields" or "brush land," where very few trees have yet to be established, may provide new information on this land type and its ability to retain nitrogen. Version 4.3 includes 527,233 acres of "Mixed Open" land in New York, which may contain substantial amounts of old field/brush land. Scientific literature on the subject suggests that these transitional forest lands are likely to retain significant amounts of nitrogen. A study in Minnesota estimated that nitrogen retention in abandoned fields accounted for all of the atmospheric nitrogen deposition, and that abandoned agricultural fields could potentially sequester nitrogen for approximately 300 years (2). The USC is beginning to map old fields and forests on its GIS database to determine acreage and location and also is partnering with Cornell to begin research on determining the potential of old fields in the upper Susquehanna to sequester nitrogen.

Tree Speciation
Additional information on the effect of tree species on nitrogen retention is needed. Nitrogen saturation of forests could lead to changes in tree species composition (3). Tree species may play an important role in nitrogen retention in forests and subsequently influence stream chemistry (4). Recent evidence indicates that pine forests become saturated more rapidly than hardwood forests (5). In northern hardwoods of the eastern United States, sugar maple is among the dominant species (6). Areas dominated by sugar maple are associated with soils having high rates of nitrification and subsequent nitrate leaching to surface waters. For reasons yet to be fully understood, sugar maple trees may create these soil conditions. It appears that because sugar maple leaves have a low lignin to nitrogen ratio, this allows soil microbes to quickly decompose the litter, consequently reducing soil carbon to nitrogen rations and increasing nitrification (6). A competitor of the sugar maple, American beech, appears to prefer nitrate to ammonium (7). This is important because it may suggest that stands dominated by American beech may have lower nitrate export. However, American beech is showing a decline in numbers due to beech bark disease. If this continues, sugar maple trees will likely thrive, potentially increasing nitrogen export to streams and rivers (6). Local research should better define the impact of tree species within New York's Chesapeake Bay watersheds.

Soil
Better documentation on nitrogen uptake by soil bacteria and other organisms is needed. Additional research on the effects of soil type may also reveal possible ways nitrogen loss to streams and rivers could be prevented. Porous soils may reduce the retention time of nitrate, which is highly mobile, resulting in greater inputs to groundwater and potentially reducing denitrification or uptake by vegetation. Carbon-to-nitrogen ratios in forest soils are known to be well correlated with nitrogen retention (8). Additional research on the subject can provide an opportunity to manage forests to maintain high C:N ratios, potentially limiting nitrogen losses.

Climate
Better understanding of the role of climate, including temperature and rainfall intensity is needed. Among other things, global warming may affect flooding and forest growth, both of which affect nutrient movement.

Season
Surface water nitrate concentrations generally peak during snowmelt and are lowest during the growing season, when biotic uptake and denitrification are greatest (9). The snowmelt and subsequent saturated soils also yield the most runoff, which account for about half of the nitrogen yield from forested ecosystems. Reductions from emissions sources during the dormant season should show immediate response in water quality, although it will take several years of local research to demonstrate this conclusively.

Summary
To improve the basis for future planning and implementation efforts, it is important that Bay Watershed Model assumptions and basic input data are as accurate as possible. Past model outputs show why more information is needed. The year 2005 is the first year that model input data benefited from management practice data collected by the USC and WWTP monitoring data.

Table 11. New York nutrient load estimates (1000s of pounds per year)

Source Category	Nitrogen					Phosphorus				
	1985	2004	2005	2006	Tributary Strategy Goal	1985	2004	2005	2006	Tributary Strategy Goal
Agriculture	23,700	14,100	13,600	12,100	**7,900**	1,800	1,100	1,020	954	**613**
Forest/Othe rOpen Space	11,900	13,320	13,300	12,600	**10,300**	294	336	335	283	**155**
Wastewater	4,400	4,300	3,300	3,700	**2,300**	570	605	498	476	**234**
Urban Stormwater	2,500	2,100	2,100	2,000	**1,500**	170	125	125	127	**84**
Septic System	1,200	1,220	1,220	1,300	**1,200**	0	0	0	0	0
Total	43,700	35,040	33,520	31,700	**23,200**	2,070	2,166	1,978	1,840	**1,086**

Fulfilling information needs for the Bay Watershed Model is especially important because of the high levels of management practice implementation, high costs and potential for future regulatory requirements to restore Chesapeake Bay water quality, such as total maximum daily loads.

Additional water quality monitoring is occurring and will help to calibrate new model simulations and independently document nutrient and sediment levels. Even as monitoring activity increases within New York, uncertainties will exist because of ordinary confidence intervals in stream flow and water chemistry measurements and the relatively short monitoring period.

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Chapter Five MONITORING

In order to "ground truth" Bay Watershed Model predictions, the USC Scientific Support Group (SSG) developed a cost-effective water quality (WQ) monitoring strategy that investigates nutrient and sediment movement at a variety of scales. The primary purpose of such enhanced WQ monitoring is to augment current WQ monitoring at the United States Geological Survey (USGS) real-time streamflow stations. This effort seeks to answer two central questions:

1. What amounts, verified by direct measurement, of nitrogen, phosphorus and sediment are exported from New York via the Susquehanna and Chemung rivers?

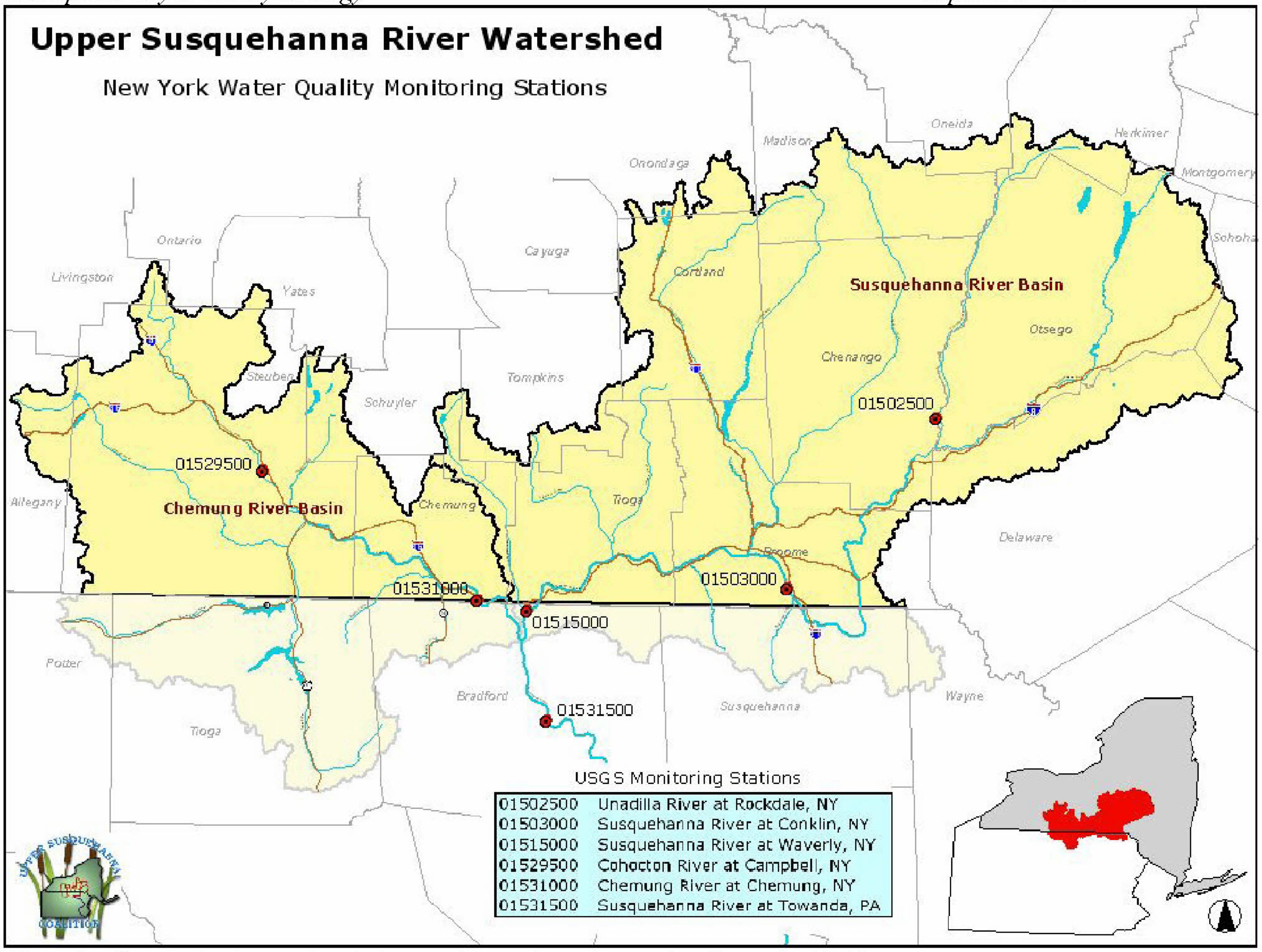
2. How are these amounts distributed across the New York portion of the Chesapeake Bay watershed according to land cover, geological composition or other factors that may affect runoff from the landscape?

By adopting a nested watershed approach, it may be possible to more definitely determine the amount of New York's nutrient and sediment export on a year-to-year as well as a subwatershed basis. Enhanced WQ monitoring will also provide more baseline data on the effect management practice implementation is having on WQ at the watershed scale. Following is a brief description of WQ monitoring that helps track nutrient and sediment reduction efforts in New York.

Total Quantity and Distribution
At Towanda, PA and five other USGS stations in New York, the Susquehanna River Basin Commission, with DEC assistance, conducts WQ sampling (see map). Monitoring at Towanda is crucial because it has a 17-year monitoring record, and measurements recorded at that point represent the entire drainage from New York. This site also is being used to calibrate Bay Watershed Model Version 5.0. The five New York sites will help describe the nutrient and sediment distribution across the New York portion of the Bay watershed.

Nutrient and sediment quantities at any point in the river are influenced by both the volume of river flow and the rate and nature of the biochemical and geological processes taking place upstream. Such nutrient cycling and changes in river volume from weather changes interact to produce substantial temporal variation (seasonal and annual) in nutrient and sediment quantities.

Current Monitoring Efforts
Samples are collected on a semi-monthly basis at Towanda and on a monthly basis for the five New York sites. One additional high-flow event per season also is sampled at each site. This sampling frequency may be inadequate to fully account for the temporal variation inherent in these systems and to quantify the current status of nutrient and sediment movement within and from New York.



Water Quality monitoring stations being used to track nutrient and sediment for NY State

Uniformity in Methodology and Monitoring Costs

One challenge to any sampling effort is uniformity in methodology. Data may include differences due to sample collection methodology or analysis. Whenever possible, uniform sample collection, preservation, transport and analysis methodologies should be adopted by all contributing partners. Government and commercial labs often are used because of consistency and quality assurance/quality control (QA/QC) that comes with EPA certification. Such analysis often is more expensive and may help explain the sample frequencies described above. Academic partners also perform high quality WQ analysis and may be a viable option for reducing monitoring costs. The strategy focuses on cost reductions by developing a network approach to sample collection within the SSG and statistically determining the optimal sample frequency of each site to eliminate inefficiencies.

To address the issues of frequency, uniformity and cost, the SSG suggested WQ monitoring strategy begin with collecting sufficient sample volume so samples can be analyzed (NO3, NH3, TN, TP) by potential participating laboratories. This will help eliminate potential inconsistencies between labs and develop a long-term inter-laboratory QA/QC program that will regularly provide high quality results.

Additional Monitoring Considerations

Management Practices: Many of the management practices used in the Bay Watershed Model currently are not being directly monitored in New York, and some important ones, such as prescribed grazing, do not have established reduction efficiencies. Although it is not fiscally possible to monitor the WQ effect at each implementation site, the SSG supports independent monitoring investigations of selected (prototypical) project sites that represent an integration of practices at the farm scale. This type of investigation will help determine loadings and reduction efficiencies and will provide necessary insight into the cost effectiveness of large scale implementation.

Computer Modeling: Small watersheds reflecting a dominant land use (forest, agriculture, urban) should be monitored with high frequency to capture variations in load and conditions within the New York portion of the Bay watershed.

Groundwater: Groundwater is estimated to contribute as much as 60 percent of the stream flow in the New York portion of the Bay watershed. This makes the movement of nutrients through groundwater an important component to understand the total nutrient mass budget for the region. This is a complex situation because the geological conditions that influence groundwater transport vary between and within sub-watersheds, and groundwater monitoring data is limited. Use of existing data sets and models may facilitate a better understanding of groundwater contributions and form the basis of a future monitoring strategy.

Monitoring Conclusion

The overall objective of New York's collective effort is to develop and execute an approach to WQ monitoring that is practical, sustainable and provides sufficient information to understand nutrient and sediment movement through the New York portion of the Bay watershed. These objectives will aid the cost-effective targeting of management practice implementation, particularly when high levels of implementation are needed to meet the Tributary Strategy goals.

APPENDICES

Management Practice Implementation Table	2010 w/06 BMP implementation (acres)	strategy implementation (acres)	maximum reference point (acres)
Agricultural BMPs			
Forest Buffers (row)	264	930	15,559
Forest Buffers (hay)	659	2,076	16,240
Forest Buffers (pasture)	1,714	5,396	12,078
Forest Buffers (Ag)	2,637	8,402	43,876
Wetland Restoration (row)	207	375	11,040
Wetland Restoration (hay)	829	1,498	11,720
Wetland Restoration (pasture)	3,110	5,618	8,369
Wetland Restoration (Ag)	4,147	7,491	31,129
Land Retirement (row)	5,424	18,489	55,366
Grass Buffers (row)	541	1,656	14,278
Grass Buffers (hay)	1,082	3,312	16,072
Grass Buffers (pasture)	1,082	3,312	11,527
Grass Buffers (Ag)	2,704	8,280	41,876
Tree Planting (row)	456	1,303	N/A
Tree Planting (hay)	618	1,764	N/A
Tree Planting (pasture)	516	1,473	N/A
Tree Planting (Ag)	1,591	4,540	N/A
Conservation Tillage	15,992	68,835	188,937
Nutrient Management Applications (Hi)	28,414	85,272	102,102
Nutrient Management Applications (Low)	2,511	48,873	68,835
Nutrient Management Applications (Hay)	33,053	169,779	239,125
Nutrient Management Applications (Ag)	63,978	303,924	428,062
Enhanced Nutrient Management Applications (Hi)	0	1,705	120,102
Enhanced Nutrient Management Applications (low)	0	977	68,835
Enhanced Nutrient Management Applications (hay)	0	66,652	239,125
Enhanced Nutrient Management Applications (Ag)	0	69,335	428,062
Nutrient Management + Enhanced Nutrients (Ag)	63,978	373,258	428,062

Agricultural BMPs, Con't.	2010 w/06 BMP implementation (acres)	strategy implementation (acres)	maximum reference point (acres)
Reduction from pre-Precision Feeding (lbs TN)	0	1,600,563	16,005,625
Reduction from pre-Precision Feeding (lbs TP)	0	281,763	2,817,634
Conservation Plans/SCWQP (Hi)	18,127	106,063	120,102
Conservation Plans/SCWQP (low)	1,592	60,789	68,835
Conservation Plans/SCWQP (hay)	21,084	211,173	239,125
Conservation Plans/SCWQP (pasture)	15,570	171,951	194,711
Conservation Plans/SCWQP (Ag)	56,372	549,976	622,772
Cover Crops-Late Planting (Hi)	0	38,998	120,102
Cover Crops-Late Planting (low)	0	22,351	68,835
Cover Crops-Late Planting (row)	0	61,349	188,937
Commodity Cover Crops-Late Planting (Hi)	0	14,421	120,102
Commodity Cover Crops-Late Planting (low)	0	8,265	68,835
Commodity Cover Crops-Late Planting (row)	0	22,686	188,937
CCLATE + CCCLATE (Row)	0	84,035	188,937
Off-Stream watering w/ fencing (Pasture)	8,379	151,761	194,711
Off-Stream watering w/o fencing (Pasture)	384	27,000	194,711
Intensive Rotational Grazing (Pasture)	14,398	0	194,711
Pasture Grazing BMP's (Pasture)	23,160	178,761	194,711
Intensive Rotational Grazing (Row Conversion)	2,880	23,865	N/A
Waste Management Systems (Manure Acres)	517	613	877
Urban and Mixed Open BMPs			
Forest Buffers (MO)	0	7,163	35,817
Wetland Restoration (MO)	0	4,000	22,943

Urban and Mixed Open BMPs, Con't.	2010 w/06 BMP implementation (acres)	strategy implementation (acres)	maximum reference point (acres)
Forest Buffers (PU)	0	955	4,774
Grass Buffers (PU)	0	3,341	N/A
Tree Planting (MO)	0	400,000	N/A
Horse Pasture Management (MO)	0	4,375	N/A
Wet Ponds & Wetlands (MO)	0	5,400	542,492
Wet Ponds & Wetlands (PU)	0	1,700	140,164
Wet Ponds & Wetlands (IU)	0	800	69,542
Wet Ponds & Wetlands (Urban)	0	2,500	209,706
Dry Extended Detention Ponds (PU)	0	0	140,164
Dry Extended Detention Ponds (IU)	0	0	69,542
Dry Extended Detention Ponds (Urban)	0	0	209,706
Urban Infiltration Practices (PU)	0	850	140,164
Urban Infiltration Practices (IU)	0	150	69,542
Urban Infiltration Practices (Urban)	0	1,000	209,706
Erosion and Sediment Control (PU)	0	69,748	N/A
Erosion and Sediment Control (IU)	0	34,605	N/A
Erosion and Sediment Control (Urban)	0	104,353	N/A
Stormwater Mgmt + Erosion & Sed Control	0	107,853	209,706
Mixed Open Nutrient Management (MO)	529,385	120,000	542,492
Non-Urban Stream Restoration (MO feet)	0	60,000	N/A
Septic Pumping (systems)	0	116,892	116,892

Chesapeake Bay Program Watershed Model Version 4.3 Output

Source	Nitrogen (lbs/yr) generated w/06 BMPs	Nitrogen (lbs/yr) generated w/TS implementation	Phosphorus (lbs/yr) generated w/06 BMPs	Phosphorus (lbs/yr) generated w/TS implementation
Agriculture	12,093,316	7,978,646	953,538	588,068
Forest	9,779,420	11,243,333	68,513	79,157
Urban	2,003,523	1,539,110	126,753	84,351
Mixed Open	2,512,011	656,903	195,021	48,366
Point Source	3,744,000	2,037,425	476,391	233,531
Septic	1,255,105	1,192,351	0	0
Non-tidal Water Dep	355,005	355,005	18,907	18,907
All Sources	31,742,379	25,002,773	1,839,122	1,052,380
Source				
High Till	5,988,340	2,583,145	411,461	211,516
Low Till	378,171	1,323,429	18,749	78,636
Hay	2,526,537	2,326,497	158,515	101,348
Pasture	2,367,453	1,106,096	263,558	118,833
Manure	832,815	639,479	101,255	77,735
Forest	9,779,420	11,243,333	68,513	79,157
Perv Urban	1,424,282	1,062,000	91,908	57,964
Imp Urban	579,241	477,110	34,845	26,386
Mixed Open	2,512,011	656,903	195,021	48,366
Point Source	3,744,000	2,037,425	476,391	233,531
Septic	1,255,105	1,192,351	0	0
AtDep Water	355,005	355,005	18,907	18,907
All Sources	31,742,379	25,002,773	1,839,122	1,052,380

Source	Sediment (tons/yr) generated w/06 BMPs	Sediment (tons/yr) generated w/TS implementation
Agriculture	155,922	89,026
Forest	97,412	112,549
Urban	21,201	13,086
Mixed Open	41,150	9,377
Point Source	0	0
Septic	0	0
Non-tidal Water Dep	0	0
All Sources	315,685	224,038
Source		
High Till	91,456	39,787
Low Till	1,810	7,109
Hay	36,854	33,420
Pasture	25,803	8,711
Manure	0	0
Forest	97,412	112,549
Perv Urban	21,201	13,086
Imp Urban	0	0
Mixed Open	41,150	9,377
Point Source	0	0
Septic	0	0
AtDep Water	0	0
All Sources	315,685	224,038

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